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SEVEN NEW CACTI (CACTACEAE: OPUNTIOIDEAE) FROM THE BAJA CALIFORNIA REGION, MÉXICO

JON P. REBMAN
San Diego Natural History Museum, P.O. Box 121390, San Diego, California 92112-1390, USA
jrebman@sdnhm.org

ABSTRACT

As a result of the author's doctoral biosystematic study of the genus *Cylindropuntia* in Baja California, plus subsequent field exploration and continued taxonomic research on the flora of this region in northwestern México, various new cactus taxa have been discovered. Seven new cacti including six chollas (*Cylindropuntia alcahes* (F. A. C. Weber) F. M. Knuth var. *gigantensis* Rebman, *C. alcahes* var. *mcgillii* Rebman, *C. cedrosensis* Rebman, *C. ganderi* (C. B. Wolf) Rebman & Pinkava var. *catavinensis* Rebman, *C. libertadensis* Rebman, and *C. waltoniorum* Rebman) and one new species of prickly-pear (*Opuntia clarkiorum* Rebman) endemic to the Baja California peninsula and adjacent islands are described here for the first time. Distribution, associated vegetation, rarity, affinities to other related species, botanical illustrations, and various keys for identification of these cacti in the region are also presented.

RESUMEN

Como resultado del estudio biosistemático doctoral del autor del género de *Cylindropuntia* en Baja California, más exploración de campo y la posterior investigación taxonómica continúa en la flora en el noroeste de México, se han descubierto varios taxones de cactus endémica de esta región. Siete nuevos cactáceas incluyiendo seis chollas (*Cylindropuntia alcahes* (F. A. C. Weber) F. M. Knuth var. *gigantensis* Rebman, *C. alcahes* var. *mcgillii* Rebman, *C. cedrosensis* Rebman, *C. ganderi* (C. B. Wolf) Rebman & Pinkava var. *catavinensis* Rebman, *C. libertadensis* Rebman, y *C. waltoniorum* Rebman) y una nueva especie de nopal (*Opuntia clarkiorum* Rebman) endémica de la península de Baja California y las islas adyacentes se describen aquí por primera vez. Se presentan la distribución, vegetación asociada, rareza, afinidad con otras especies en el género, ilustraciónes botánicas del nuevos taxónes, y varias claves por la identificación de estos cactáceas en la región.

Key Words: Baja California, Cactaceae, cacti, *Cylindropuntia*, *Opuntia*, México.

Baja California is comprised of two Mexican states (Baja California and Baja California Sur) that are politically divided at the 28th parallel. These states comprise the Baja California peninsula and its adjacent islands located in both the Gulf of California (Sea of Cortés) and the Pacific Ocean. This region supports a wealth of plant species diversity. It was estimated by Wiggins (1980) that 2958 total taxa and 686 endemic species occur in Baja California, but recent plant discoveries and a more complete overview of the literature and herbaria research suggests that the flora probably consists of more than 4500 plant taxa with a rate of endemism closer to 30%. The Cactaceae is a dominant and diverse component in most areas and plant communities of Baja California. According to Rebman (2001), the Cactaceae of Baja California are represented by 15 genera, 104 species, and 129 total taxa. Of these, 71 species and 92 taxa are endemic to the region, a 68.3% endemism rate for species, and 71.3% for all cactus taxa. The genus *Opuntia* Miller *sensu lato* in Baja California (including *Grusonia* K. Schum. (*Corynopuntia* F. M. Knuth to some authors), *Cylindropuntia* (Engelm.) F. M. Knuth, and *Opuntia sensu stricto*) was considered to have the highest number of overall taxa (41) in the region before it was split into three genera by Anderson (2001).

The Baja California peninsula and its adjacent Pacific and Gulf islands are found to contain 21 species (29 taxa) of *Cylindropuntia* (see Appendix 1), of which 12 (18 taxa) or 57.1% (62.1% of taxa) are endemic. This high variation of chollas makes Baja California the region with the greatest taxonomic diversity of the genus *Cylindropuntia* and most likely reflects the influence of past geological events, habitat diversity, desert pocketing, and isolation in the region during the Pleistocene, as well as past and present floristic associations. This paper describes six new cholla taxa (*Cylindropuntia alcahes* (F. A. C. Weber) F. M. Knuth var. *gigantensis* Rebman, *C. alcahes* var. *mcgillii* Rebman, *C. cedrosensis* Rebman, *C. ganderi* (C. B. Wolf) Rebman & Pinkava var. *catavinensis* Rebman, *C. libertadensis* Rebman, and *C. waltoniorum* Rebman) and one new species of prickly-pear (*Opuntia clarkiorum* Rebman). In Baja California, chromosome studies (Rebman 1995) indicate that 67% of cholla taxa

are diploid, but some occasionally have putative autopolyploid individuals. If these autopolyploid taxa are considered, then up to 52% of the taxa have all or some members with polyploid counts. The range of euploidy varies from $2x$ to $8x$ ($x = 11$), with the octoploids reported as the highest polyploid level determined for the genus. Chromosome counts for *Cylindropuntia waltoniorum* and *Opuntia clarkiorum* are reported here for the first time and new specimens confirming previously published chromosome counts are provided for *C. alcahes* var. *mcgillii* and *C. ganderi* var. *catavinensis*.

Rebman's 1995 dissertation represents the first comprehensive monograph of the chollas (*Cylindropuntia*) of Baja California (northwestern Mexican states of Baja California [BC] and Baja California Sur [BCS]) and adjacent Gulf and Pacific islands classically considered to be part of this region. The methods used in the biosystematic investigation of *Cylindropuntia* for this taxonomic research include: chromosome studies, pollen stainability, scanning electron microscopy (SEM) of pollen, seed surfaces, and certain vegetative structures, field and herbarium analyses of morphology, cladistics, and biogeographical data mapping. Of the six new *Cylindropuntia* taxa described in this paper, five were recognized in the author's dissertation (*C. waltoniorum* was recognized as the hybrid formula "*C. lindsayi* × *C. alcahes*"). Other chollas recognized as new taxa in the dissertation (Rebman 1995) and were described previous to this paper include: *C. lindsayi* (Rebman) Rebman (Rebman 1997), *C. sanfelipensis* (Rebman) Rebman (Rebman 1999), and *C. delgadilloana* Rebman & Pinkava (Rebman and Pinkava 2001). Continued floristic research in Baja California has revealed many other plants new to science (Rebman and Chiang 2005; Rebman 2006; León de la Luz and Rebman 2010; Guilliams et al. 2011; Simpson and Rebman 2013) including the relatively recent discovery of the rare *C. libertadensis* being described in this paper that was found in a very remote and botanically underexplored part of the central peninsula. The author started biosystematic study of the genus *Opuntia sensu stricto* in Baja California in 1998, and *O. clarkiorum* represents the first new species described as a result of that ongoing taxonomic research.

Taxonomic Treatment

Cylindropuntia alcahes (F. A. C. Weber) F. M. Knuth var. ***gigantensis*** Rebman, var. nov. (Figs. 1, 2 map). *Cylindropuntia alcahes* (F. A. C. Weber) F. M. Knuth subsp. *gigantensis* (Rebman) U. Guzmán, Cactaceae Systematics Initiatives: Bulletin of the International Cactaceae Systematics Group 16:16. 2003, nom. nud.—TYPE: MÉXICO, Baja California Sur, 111°58′W, 26°19′N, lava fields on the road to La Purísima, 24 May 1992, *Rebman et al. 1404* (holotype: ASU 187536; isotypes: BCMEX 5106, HCIB 3277; DES 00037111).

Shrubs, occasionally with a definite trunk, 0.5–2 m tall, with open, divaricate branching. Stem segments cylindrical (6–)7.5–17 × 1.4–2.2 cm; tubercles (13–)15–20 × 3–5 mm, 3–5 mm high. Areoles 3–5 × 2–3 mm. Spines with orange-brown bases and light yellow tips, or yellow throughout, aging gray, 5–9 per areole, mostly equal in length, 7–15 mm, central spines (1)2–4, radial spines 4–6; sheaths with cream bases and yellow tips. Glochids light yellow, inconspicuous, 1–2 mm, in apical tuft. Flowers: inner tepals green, yellow, to red-maroon, outer tepals usually with reddish apices, 17–22 × 7–10 mm; ovary 21–27(–36) × 9–19 mm. Fruits green to yellow, clavate, frequently proliferating into a chain of two; 26–50 × 14–26 mm; areoles 26–35. Seeds 0–50, spheric to slightly compressed laterally, 3.5–5 mm diam.. Chromosome number $2n = 22$ (based on *Baker 8726a & Johnson; Baker 8744 & Johnson; Rebman et al. 1409*; all counts originally published as *Opuntia alcahes* var. nov. "A" in Pinkava et al. [1998]).

Paratypes: MÉXICO, BAJA CALIFORNIA SUR. 20 km W of Rosarito & ca. 70 km S of Mulegé, 8 Jan 1982, *Baker 4036a* (ASU); 12 mi W of Rte. 1 on road to San Isidro, 1 Mar 1992, *Baker 8726a & Johnson* (ASU, BCMEX, SD); just NE of San Miguel Comondú, 3 Mar 1992, *Baker 8744 & Johnson* (ASU); Purísima, 24 Apr 1952, *Harbison s.n.* (SD); 7.9 mi W of San Javier, 1 Apr 1961, *Lindsay 3082 & Parrish* (ASU); 6.4 mi W of San Javier, 22 May 1961, *Lindsay 3149* (SD); Canipole, 23 May 1959, *Moran 7470* (SD, U.S.); 13 km S of San Ignacio along Rte. 1 near km marker 60, 17 May 1991, *Rebman & Rice 1163* (ASU, SD); near Santo Domingo along Rio San Javier, 23 May 1992, *Rebman et al. 1400* (ASU, BCMEX, HCIB, SD); just W of Rte. 1 toward San Isidro, 26 May 1992, *Rebman et al. 1409,* (ASU, BCMEX, HCIB, SD); N of jct. to Rosarito & San José de Comondú, along road between La Purísima & Rosarito, 12 Aug 1994, *Rebman 2871 & Arias* (ASU, BCMEX, HCIB, SD); W of Mulegé, vicinity of Rancho El Tule, 27 Apr 1998, *Rebman 5183* (SD); 0.5 mi off of road to La Purísima on road to Los Naranjos, 27 Oct 2001, *Rebman 7794* (HCIB, SD).

Phenology. Flowering March to May, rarely in August.

Distribution and ecology. Sonoran Desert, mostly in the La Giganta Ranges ecoregion, but also at the southern edge of the Vizcaíno Desert ecoregion and the eastern edge of the Magdalena Plains ecoregion; 200–500 m in elevation; endemic to the central part of the state of Baja

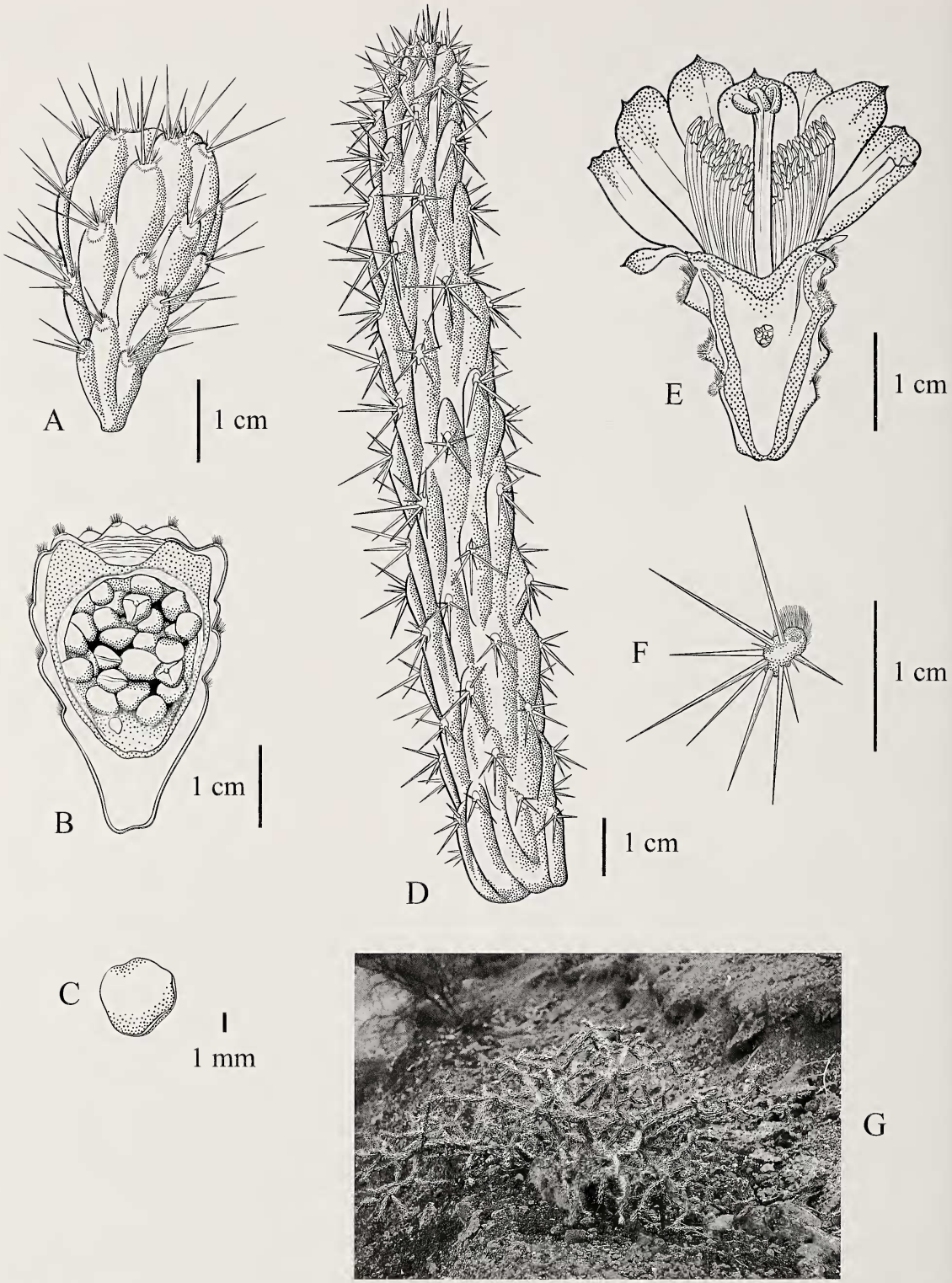

FIG. 1. *Cylindropuntia alcahes* var. *gigantensis*. A. Fruit (*Rebman 7794*, photo *Rebman P03795*). B. Fruit section (*Rebman 1409, Rebman 7794*). C. Seed (*Rebman 1409*). D. Stem segment (*Rebman 1409*). E. Flower (*Rebman 5183*). F. Areole spine cluster (*Rebman 1409*). G. Growth habit (photo *Rebman P03792*). Note: numbered photos are from digital archives on bajaflora.org.

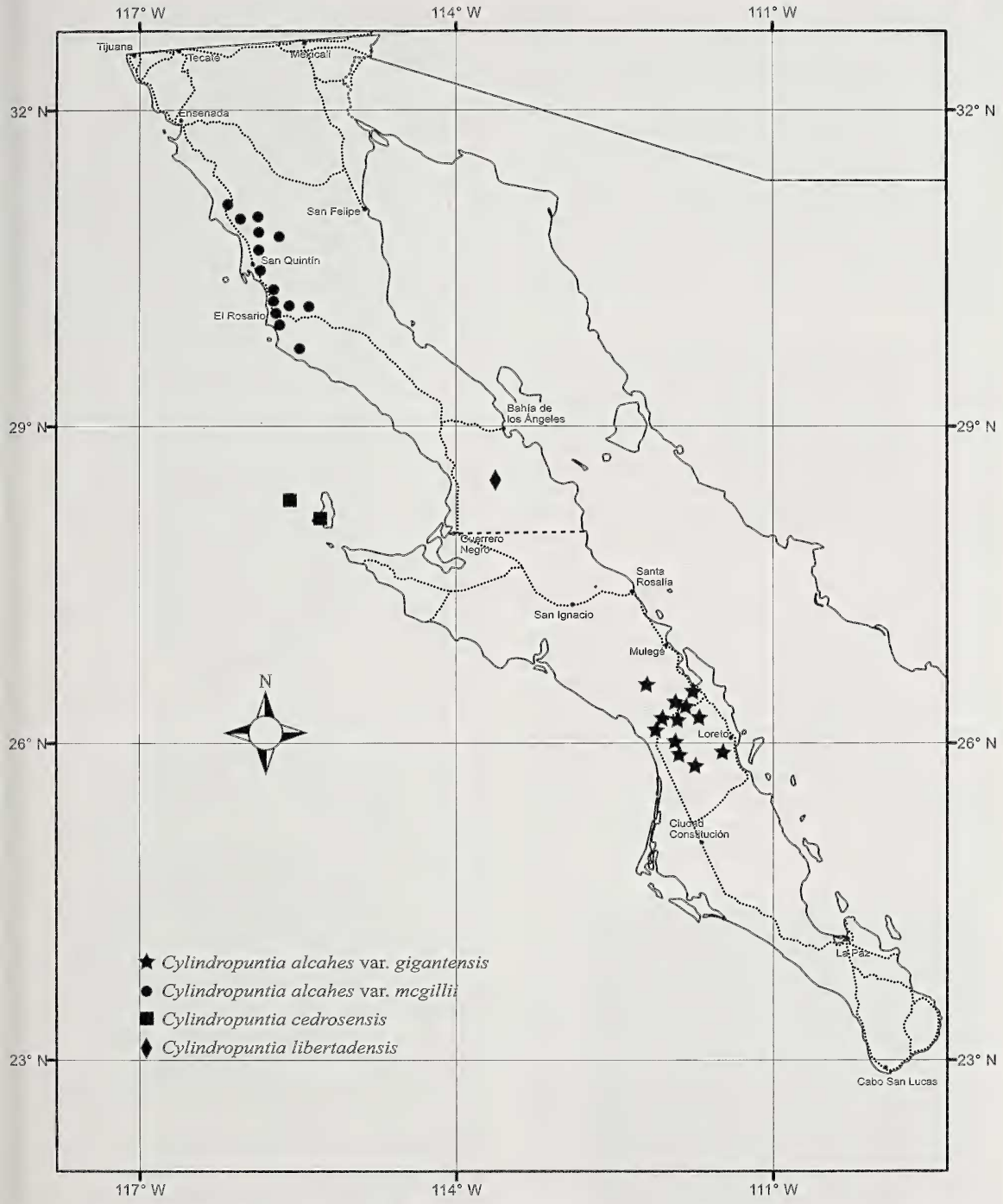

FIG. 2. Map of the Baja California region showing the distribution *Cylindropuntia alcahes* var. *gigantensis* (stars), *Cylindropuntia alcahes* var. *mcgillii* (circles), *Cylindropuntia cedrosensis* (squares), and *Cylindropuntia libertadensis* (diamond).

California Sur, especially common on volcanic flats and hillsides from vicinity of San Ignacio to La Purísima. *Cylindropuntia alcahes* var. *gigantensis* seems to be almost restricted to the vicinity of the Sierra de la Giganta region, but thus far has only been documented in few collections. This new variety is often found in desert scrub vegetation in association with *Cylindropuntia cholla* (F. A. C. Weber) F. M. Knuth, *C. ciribe* (J. M. Coult.) F. M. Knuth, *Echinocereus brandegeei* (J. M. Coult.) K. Schum., *Jatropha cinerea* (Ortega) Müll. Arg, *J. cuneata* Wiggins &

R. C. Rollins, *Larrea tridentata* (DC.) Coville, *Lophocereus schottii* (Engelm.) Britton & Rose var. *schottii, Lysiloma candidum* Brandegee, *Pachycereus pringlei* (S. Watson) Britton & Rose, *Prosopis palmeri* S. Watson, *Ruellia californica* (Rose) I. M. Johnst., *Sebastiania bilocularis* S. Watson, and *Stenocereus thurberi* (Engelm.) Buxb.

Etymology. This new variety of *Cylindropuntia alcahes* is named with respect to its range of distribution, which is mainly in the Sierra de La Giganta on the eastern side of central BCS. Suggested English common name is La Giganta Cholla.

Taxonomic relationships. In general habit, this taxon resembles *Cylindropuntia spinosior* (Engelm.) F. M. Knuth and *C. versicolor* (Toumey) F. M. Knuth of Arizona with its openly arranged, whorled branches, but differences in fruit, flower, and distribution substantiate no close relationships to these species. *Cylindropuntia alcahes* var. *gigantensis* commonly has long, clavate fruits, which are not usually found in other varieties of *C. alcahes*.

Putative hybrids or morphological intermediates in spine color and growth habit with *Cylindropuntia alcahes* var. *burrageana* (Britton & Rose) Rebman (*Rebman 1664 & Davis*) and *C. alcahes* var. *alcahes* (*Baker 8710 & Johnson*) have been documented rarely in sympatric areas. *Cylindropuntia alcahes* var. *burrageana* is basically restricted to the Cape region of southern BCS and to Espíritu Santo Island adjacent to La Paz. However, this variety does rarely occur northward along the Gulf of California to the southeastern part of the Sierra de La Giganta and it is in this part of its range where intermediates with *C. alcahes* var. *gigantensis* can be encountered. *Cylindropuntia alcahes* var. *alcahes* has the widest distribution and is the most morphologically variable of all the varieties of *C. alcahes*. The morphology of *C. alcahes* var. *alcahes* varies from tree-like entities with a single trunk, similar in physiognomy to *C. prolifera* (Engelm.) F. M. Knuth of northwestern BC to more densely spined forms that occur near Bahía de los Angeles, to subshrubs in BCS. However, the distinctive club-shaped fruits of *C. alcahes* var. *gigantensis* have never been observed in *C. alcahes* var. *alcahes* even in adjacent populations from the Sierra de La Giganta region.

Cylindropuntia alcahes (F. A. C. Weber) F. M. Knuth **var. *mcgillii*** Rebman, var. nov. (Figs. 3, 2 map). *Cylindropuntia alcahes* (F. A. C. Weber) F. M. Knuth subsp. *mcgillii* (Rebman) U. Guzmán, Cactaceae Systematics Initiatives: Bulletin of the International Cactaceae Systematics Group 16:16. 2003, nom. nud.—TYPE: MÉXICO, Baja California, 115°47′W, 30°09′N, ca. 8 mi N of El Rosario along Rte. 1, at km marker 42, 31 May 1991, *Rebman 1219 & Cota* (holotype: ASU 186273; isotypes: BCMEX 5581, SD 137583).

Trees or shrubs, with densely compact terminal branchlets, 0.5–2.5 m. Stem segments short, (2–) 3.5–6(–7) × 1.5–2(–2.4) cm, heavily spined and almost obscuring tubercles beneath; tubercles 4–8(–11) × 2–4 mm, 2–4 mm high. Areoles 3–4 × 2–3 mm. Spines with orange-brown bases and yellow tips, or light yellow throughout, aging dark brown to gray, 6–11 per areole, almost equal in length, 9–19 mm, the central spines 2–4, the radial spines 4–7; sheaths tan to golden-yellow. Glochids light yellow to tan, conspicuous, 2–3 mm, forming a crescent over the upper one-third of the areole. Flower: inner tepals red-maroon throughout, or with greenish bases, 14–17 × 5–8 mm; ovary 15–21 × 13–20 mm. Fruits green or yellow-green, globose, 20–32 × 15–30 mm, frequently proliferating into chains of 2–3, areoles 40–52. Seeds (0–)15–30, spheric, 2.5–3.5 mm diam. Chromosome number $2n = 22$ (based on *Pinkava et al. 11134*; *Pinkava et al. 11175; Rebman 941 & Marsh*; *Rebman 1136 & Rice; Rebman 1219 & Cota*; all counts originally published as *Opuntia alcahes* var. nov. "B" in Pinkava et al. [1998], except *Rebman 941 & Marsh* which is reported here for the first time).

Paratypes: MÉXICO, BAJA CALIFORNIA. ca. 10 km NNE of Punta Canoas, 15 Feb 1997, *Baker 12336 & Johnson* (SD); Arroyo del Rosario, 5.5 mi E of El Rosario & 4.5 mi NE of Rte. 1, 25 May 1975, *Hensel 343 & Garmon* (ASU); 3.2 mi S of Colonia Guerrero, 14 Jul 1962, *Lindsay 3348* (SD); 5.4 mi E of new village, El Rosario, 16 Jul 1962, *Lindsay 3354* (ASU, MEXU, SD); San Quintín Bay, 7 Jun 1925, *Mason 2063* (CAS); 115°51′W, 30°53′N, 5 Jun 1976, *Moran 23490* (SD); Rte. 1, 5.2 mi N of Camalú, 6 Jun 1972, *Pinkava et al. 9029, 9030* (ASU); Rte. 1, 11.4 mi S of the northern limits of Camalú, 1 Jun 1973, *Pinkava et al. 11134* (ASU); 3.4 mi N of El Rosario on Rte. 1, 3 Jun 1973, *Pinkava et al. 11175* (ASU); Rte. 1, just S of Vicente Guerrero, 22 May 1974, *Pinkava et al. 12094* (ASU); Arroyo del Rosario, 5.5 mi E of El Rosario & 4.5 mi NE of Rte. 1, 24 May 1974, *Pinkava et al. 12148* (ASU); Rte. 1, ca. 23 mi S of El Rosario, 24 May 1974, *Pinkava et al. 12162c* (ASU); ca. 3 mi S of Punta Baja & 1.5 mi inland, 19 Mar 1991, *Rebman 941 & Marsh* (ASU, SD); 17 mi E of Rte. 1 on the road to San Telmo & 5 mi further on the road marked "Ranches" going south, 13 May 1991, *Rebman 1136 & Rice* (ASU, BCMEX, SD); 7.5 mi E of Rte. 1 on road to Mission Santo Domingo, 30 May 1991, *Rebman 1207 & Cota* (ASU, BCMEX); Hillside just E of Hamilton Ranch, 30 May 1991, *Rebman 1209 & Cota* (ASU, BCMEX); ca. 8 mi N of El Rosario along Rte. 1, at km marker 42, 31 May 1991,

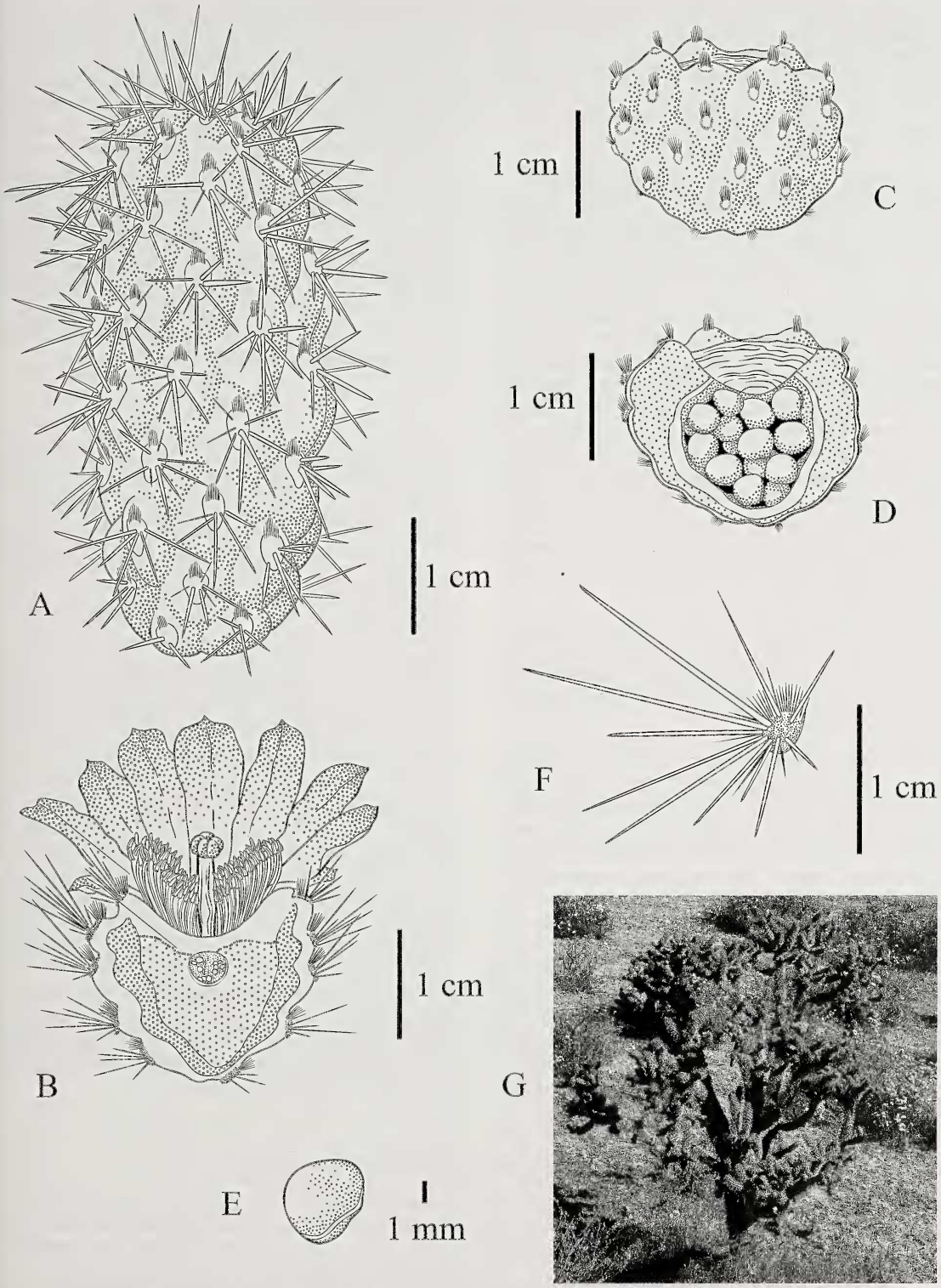

FIG. 3. *Cylindropuntia alcahes* var. *mcgillii* A. Stem segment (*Rebman 1219*, photo *Rebman P01794*). B. Flower (*Rebman 1219*). C. Fruit (*Rebman 1219*, photo *Rebman P01793*). D. Fruit section (*Rebman 1136*). E. Seed (*Rebman 1136*). F. Areole spine cluster (*Rebman 1219*). G. Growth habit (photo *Rebman P01792*). Note: numbered photos are from digital archives on bajaflora.org.

Rebman 1219 & Cota (ASU); 4 mi N of Lazaro Cardenas and 2.3 mi E of Rte. 1, 15 Apr 1993, *Rebman 1650 & Davis* (ASU); 20.3 mi S of San Quintín turnoff, 10 Oct 1966, *Turner 66-96 & Hastings* (ARIZ).

Phenology. Flowering May to June.

Distribution and ecology. Mediterranean region/Sonoran Desert mostly in the Coastal Succulent Scrub ecoregion and in the extreme northwestern part of the Central Desert ecoregion; 10–200 m elevation; endemic to the west-central part of the state of Baja California, especially common on coastal flats and hillsides near the Pacific Ocean from Camalú to the vicinity of El Rosario. This new variety is often found in coastal scrub vegetation in association with *Agave shawii* Engelm. subsp. *shawii, Ambrosia chenopodiifolia* (Benth.) W. W. Payne, *Bahiopsis laciniata* (A. Gray) E. E. Schill. & Panero, *Bergerocactus emoryi* (Englem.) Britton & Rose, *Cylindropuntia cholla, Eriogonum fasciculatum* Benth., *Euphorbia misera* Benth., *Myrtillocactus cochal* (Orcutt) Britton & Rose, *Rosa minutifolia* Engelm., and *Stenocereus gummosus* (Engelm.) A. C. Gibson & K. E. Horak.

Etymology. This variety is named in honor of Lyle A. McGill, the botanist, for his contributions to cactus research in Baja California and Arizona. Suggested English common name is McGill's Cholla.

Taxonomic relationships. This new variety grows mainly along the Pacific coast from Camalú to El Rosario, and occurs sympatrically with *C. prolifera* and rarely with *C. alcahes* var. *alcahes*. In fact, *C. alcahes* var. *mcgillii* resembles *C. prolifera* except for shorter, finer spination, tubercle dimensions, fertile fruits, and smaller stem segments. However, stronger affinities exist between this variety and the *C. alcahes* complex, which warrants its current classification. At least one specimen (*Pinkava 9069*) appears to be intermediate between *C. alcahes* var. *mcgillii* and *C. alcahes* var. *alcahes*, and is found in the sympatric region of these varieties near El Rosario. This intermediate specimen has a published chromosome count of $2n = 33$ (published as *Opuntia prolifera* in Pinkava et al. [1992], changed to *Opuntia alcahes* var. nov. "B" in Pinkava et al. [1998]), further substantiating this non-typical and putative hybrid individual. *Cylindropuntia alcahes* var. *mcgillii* is almost completely restricted to the Coastal Succulent Scrub ecoregion with only a couple of outliers just to the south along the immediate Pacific coast. This new variety grows in the agricultural areas near Colonet and San Quintín and has definitely been impacted by development in that region. Due to its rather restricted distribution and development pressures in this region, *C. alcahes* var. *mcgillii* is becoming rarer and should be considered for conservation measures.

Discussion

The name *Cylindropuntia alcahes* was not listed in Wiggins's (1980) floristic treatment of the Cactaceae for Baja California, but is one of the most common cholla species on the peninsula and is extremely well represented on the islands in the Gulf of California. However, Wiggins did recognize a few minor variants of this widespread species under the named synonyms *Opuntia brevispina* H. E. Gates and *Opuntia echinocarpa* Engelm. & J. M. Bigelow var. *nuda* J. M. Coult. Based upon the taxonomic monograph presented by Rebman (1995) of the chollas in the Baja California region, *C. alcahes* is the oldest and correct name for this species. This widespread and variable species is now recognized with four varieties (two described here) that share similar flower color variability, fleshy spineless fruits that frequently yellow at maturity, and spheric to almost pearl-like seeds. These varieties exhibit rather different suites of character states allowing them to be differentiated. Due to a high degree of phenotypic plasticity, especially in *C. alcahes* var. *alcáhes*, and considerable intermediacy in sympatric populations among varieties, these taxa are best treated at the varietal level. This species is mostly endemic to the Baja California region with only *C. alcahes* var. *alcahes* extending into Sonora on San Esteban Island.

Key to the varieties of *Cylindropuntia alcahes*

1. Tubercle length less than 8 mm; terminal stem segments short, 2–6(–7) cm long; glochids conspicuous; branches densely compact at least on younger stems; plants of Pacific coast between Camalú and the vicinity of El Rosario . . . . . *C. alcahes* var. *mcgillii*

1′. Tubercle length longer than 8 mm; terminal stem segments long, generally greater than 7 cm long (except sometimes shorter for *C. alcahes* var. *alcahes* on some islands in the Gulf of California); glochids mostly inconspicuous; branches variously arranged, but usually more openly branched; plants generally found south of El Rosario.

2. Fruits mostly long clavate, 26–50 mm in length; tubercles (13–)15–20 mm and with stems less than 2.2 cm diam.; branching habit widely divaricate . . . . . *C. alcahes* var. *gigantensis*

2′. Fruits usually globose, 15–27 mm in length; tubercles generally less than 15 mm and with a stem diam. more than 2 cm; branching habit various, commonly closely arranged.

3. New stem growth bright golden; shrubs rather low and sprawling, mostly in the Cape region of Baja California Sur; spine number 12–21, with central and radial spines not readily distinguishable ..... *C. alcahes* var. *burrageana*
3′. Younger stems yellow, reddish-brown, or dark gray, not strongly golden; trees or shrubs, well-distributed on the Baja California peninsula and on many islands in the Gulf of California, but not in the Cape region; spine number usually 2–15, with 1–6 central and 2–11 radial spines ..... *C. alcahes* var. *alcahes*

Cylindropuntia cedrosensis Rebman, sp. nov. (Figs. 4, 2 map).—TYPE: MÉXICO, Baja California, Cedros Island, 115°16′W, 28°12′N, Bahía del Sur near the fishing village of Wayle, 22 Mar 1994, *Rebman et al. 2495* (holotype: ASU 195927; isotypes: BCMEX 6941, SD 138739).

Shrubs, low and sprawling, 0.5–1 m tall and 2–3 m across; terminal branchlets detached easily as propagules, therefore some populations may be clonal. Stem segments cylindrical, green to gray-green, 3.0–7.0 × 2.8–3.7 cm; tubercles salient, broadly oval, 17–25 × 8–10 mm, 5–8 mm high. Areoles cream, aging dark gray, 9–10 × 5–6 mm. Spines at most areoles, orange to light yellow, aging dark gray, 10–12 per areole, 34–44 × 1–1.5 mm, the central spines 3–6, the radial spines 5–7; sheaths with light gray base and yellowish-orange tip, baggy. Glochids inconspicuous, cream to dark yellow, in apical tuft, 2–3 mm. Flowers: unknown. Fruits green to gray-green, fleshy, spiny, not proliferating, strongly compressed vertically making it wider than long, 17–24 × 30–36 mm; umbilicus 18–22 mm wide and 10–11 mm deep; areoles 24–30. Seeds unknown. Chromosome number unknown.

Paratypes: MÉXICO, BAJA CALIFORNIA. West San Benito Island, 19 Apr 1948, *Lindsay 547* (SD); West San Benito Island, 25 Mar 1974, *Moran 21174* (SD); West San Benito Island, 20 Jan 1975, *Philbrick B75-34* (SBBG); San Benitos Islands, 9 Jan 1972, *Voss s.n.* (SD); West San Benitos Islands, 13 Feb 1972, *Voss 1206* (SD).

Phenology. Flowers are not yet known for this species and fruits were documented on specimens in March 1994, appearing to remain on the individuals throughout much of the year.

Distribution and ecology. Pacific Island/Vizcaíno Desert ecoregions; 10–50 m elevation; endemic to the southwestern part of Cedros Island and scattered on West San Benitos Island, especially common on rocky and sandy washes and flats near the Pacific Ocean. This new species is found in maritime desert scrub vegetation in association with *Agave sebastiana* Greene, *Atriplex barclayana* (Benth.) D. Dietr., *Cochemiea pondii* (Greene) Walton, *Deinandra streetsii* (A. Gray) B. G. Baldwin, *Errazurizia benthamii* (Brandegee) I. M. Johnst., *Ferocactus chrysacanthus* (Orcutt) Britton & Rose, *Frankenia palmeri* S. Watson, and *Malva venosa* Thunb.

Etymology. This species is named for Cedros Island off of the western coast of central Baja California from which the type specimen was obtained. Suggested English common name is Cedros Cholla.

Taxonomic relationships. This is a distinctive new species, but the flowers and chromosome number are not yet known. Although it has a general appearance similar to *Cylindropuntia prolifera*, the fruits are spiny and strongly depressed, and thus it probably is not too closely related. The combination of the fruit being fleshy and spiny, plus strongly compressed apically makes it different from all other chollas in BC and BCS. The specimen label for *Lindsay 547* (SD) from West San Benitos Island states that this species is common on both West and East San Benito islands. Thus, it is suspected that this cholla also occurs on East San Benitos Island, although there are no verifiable herbarium specimens documenting it from that island. This taxon may have also been cited by Britton and Rose (1963) as "*Opuntia* sp." (listed as *Opuntia benedicta* nom. nud. in the U.S. Herbarium's online database) from East San Benitos Island based on a cholla specimen collected on 9 March 1911, *Rose 16085* (NY, U.S.). However, this specimen is so small and depauperate that I cannot be sure if it is the same species or not.

Further investigation is warranted to obtain more detailed information about *C. cedrosensis*. It appears that this cholla species relies quite heavily on vegetative propagation to create populations as the stem segments dislodge very easily and larger individuals are typically surrounded by many smaller putative clones that have most likely arisen from fallen stem joints. The spines of the stems are strongly retrorsely barbed and easily attach to passers-by for dispersal. It should be noted that on West San Benitos Island this new species is responsible for killing various pelagic bird species such as Cassin's Auklet and storm-petrels. According to ornithologist Phil Unitt (personal communication, 2014) during fieldwork on this island in 1974, he vividly remembers extracting many bird skeletons from the chollas there in order to make specimen collections and even states that "this cholla must be a major control on the numbers of burrow-nesting seabirds that use the island." Although, I have visited both Cedros and San Benitos islands on at least two different occasions in March 1994 and February 2007,

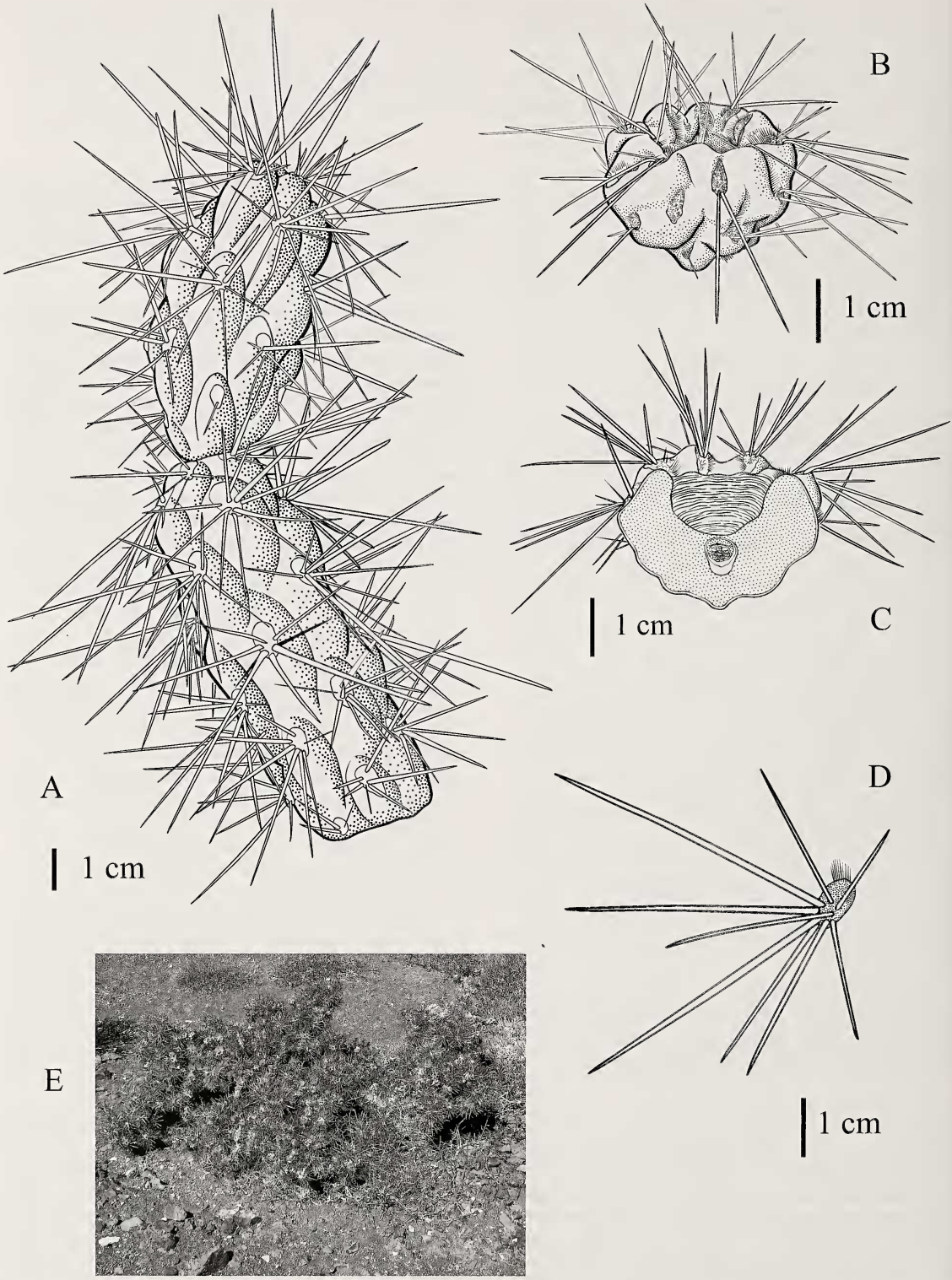

FIG. 4. *Cylindropuntia cedrosensis* A. Stem segment (*Rebman 2495*). B. Fruit (*Rebman 2495*, Rebman photo DSCN1630). C. Fruit section (*Rebman 2495*). D. Areole spine cluster (*Rebman 2495*). E. Growth habit (photo *Rebman P16898*). Note: numbered photos are from digital archives on bajaflora.org.

the flowers remain elusive and are still unknown. Furthermore, I am not aware of any individuals of this cactus species alive in cultivation at present. According to Steve Junak (personal communication, ca. 2005), there was an individual of this species planted in the Santa Barbara Botanic Garden and we were waiting for it to flower, but the Jesusita Fire in May 2009 destroyed the plant.

It should be noted that one other cholla species (*Cylindropuntia alcahes* var. *alcahes*) is also known to occur on Cedros Island on the east side of the island. This taxon is very widespread in the Baja California region and differs significantly from *C. cedrosensis* is having fruits that are yellow, spineless, and spheric (not compressed apically) at maturity.

Cylindropuntia ganderi (C. B. Wolf) Rebman & Pinkava **var. *catavinensis*** Rebman, var. nov. (Figs. 5, 6 map). *Cylindropuntia ganderi* subsp. *catavinensis* (Rebman) U. Guzmán, *nom. nud.*, Cactaceae Systematics Initiatives: Bulletin of the International Cactaceae Systematics Group 16:16. 2003.—TYPE: MÉXICO, Baja California, 114°46′W, 29°47′N, Rte. 1, ca. 2 mi N of Cataviña and 3 mi S of the road to San José Faro, 23 Apr 1993, *Rebman 1723 & Davis* (holotype: ASU 190076; isotypes: BCMEX 5854, SD 136474).

Shrubs with multiple erect branches and strict to almost linear ascending growth habit, 0.8–1.7 m; terminal branchlets not easily detached. Stem segments cylindrical, green to gray-green, densely spiny, (8.5–)12–26 × 3–4.2 cm; tubercles obovate to oblong, (13–)15–24 × 3–7 mm, 4–8 mm high. Areoles cream to golden-yellow, aging dark gray, 6–9 × 3–5 mm. Spines at all areoles, cream to pale yellow throughout or having pinkish-orange bases and cream tips, all aging dark gray to almost black, (15–)18–28 per areole, the central spines indistinguishable from radial spines, (11–)15–25(–28) × 0.7–1.0 mm; sheaths cream- to yellow-tipped. Glochids usually inconspicuous, pale yellow to pinkish-yellow, sometimes aging gray, only found in apical tuft. Flowers: inner tepals yellow, 18–27 × 11–17 mm; the outer tepals with light green midstripes and commonly red tips; filaments green, 8–12 mm, the anthers yellow to orange-yellow, 2.5–3 mm; style cream or pale yellow, 14–23 mm; stigma cream to yellow, the lobes 7–9, 2.5–5 mm; ovary 25–40 × 23–27 mm, the ovules 40–100. Fruits gray-green to tan, dry when mature, densely spined to bur-like, turbinate to barrel-shaped, 19–25 × 17–22 mm; not proliferating; lower tubercles elongate, areoles 34–50. Seeds 0–35, tan, compressed laterally, circular in outline, 4.5–6 mm diam. Chromosome number $2n = 22$ (*Baker 8785 & Johnson; Pinkava et al. 14220; Rebman 1322 & Cordova; Rebman 941 & Marsh; Van Devender et al. 91-346*; all counts originally published as *Opuntia ganderi* var. nov. "A" in Pinkava et al. [1998], except *Rebman 4986* which is reported here for the first time).

Paratypes: MÉXICO, BAJA CALIFORNIA. along road to Bahía de los Angeles, 8.2 mi E of its junction with Rte. 1, 9 Mar 1992, *Baker 8785 & Johnson* (ASU, BCMEX); 15 km S of Punta Bufeo, 11 Feb 1997, *Baker 12315 & Johnson* (ASU, SD); ca. 10 km E of the junction of Rte. 1 along the road to Bahía de los Angeles, 14 Feb 1997, *Baker 12328 & Johnson* (ASU, SD); 7 km W of Cataviña along Arroyo La Traveta, 14 Feb 1997, *Baker 12329 & Johnson* (ASU, SD); Rte. 1, ca. 54 mi S of El Rosario, 25 May 1974, *Pinkava et al. 12169* (ASU, CAS, SD), *12170* (ASU); Rte. 1, ca. 10 mi SE of San Agustín, 21 May 1984, *Pinkava et al. 14219* (ASU), *14220* (ASU, SD), *14221* (ASU); ca. 15 km from junction with Rte. 1 on the road to Bahía de los Angeles, 22 Mar 1991, *Rebman 967 & Marsh* (ASU); 3 mi N of Cataviña at km marker 170 of Rte. 1, & 0.3 mi W of the road, 14 May 1991, *Rebman 1143 & Rice* (ASU, BCMEX); ca. 25 mi W of Rte. 1 near Cataviña along the road to San José de la Piedra, 17 Mar 1992, *Rebman 1322 & Cordova* (ASU, BCMEX); ca. 2 mi N of Cataviña & 3 mi S of the road to San José Faro along Rte. 1, 23 Apr 1993, *Rebman 1723 & Davis* (ASU, BCMEX); N of Santa Rosalillita along road to San José las Palomas, 5 Mar 1994, *Rebman 2307 & Hirales* (ASU, BCMEX, SD); N of Cataviña, 1.2 mi NE of km marker 166 of Rte. 1 between El Rosario & Cataviña, 18 May 1994, *Rebman 2727, 2730 & Vincent* (ASU, BCMEX, DES, SD); ca. 5 mi N of Cataviña and 0.6 mi W of Hwy. 1, 1 Apr 1998, *Rebman 4986* (ASU, BCMEX, SD); Cataviña, 16 Apr 1986, *Salazar s.n.* (BCMEX); 5 mi NNW of Cataviña on Rte. 1, ca. 0.6 mi NE on a dirt road, 13 Mar 1991, *Van Devender et al. 91-346* (ASU).

Phenology. Flowering March to May.

Distribution and ecology. Occurs mostly in the central portions of the Central Desert ecoregion, but also known rarely from the extreme southern part of the Colorado Desert ecoregion near Bahía San Luis Gonzaga; 50–650 m; endemic to central and southern BC, especially common on sandy, decomposed granite soils among boulders near Cataviña. This new variety is found in central desert vegetation in association with: *Cylindropuntia cholla, Cylindropuntia molesta* (Brandegee) F. M. Knuth var. *molesta, Euphorbia misera, Fouquieria columnaris* (Kellogg) Curran, *Larrea tridentata, Lophocereus schottii* var. *schottii, Pachycereus pringlei, Pachycormus discolor* (Benth.) Coville, *Prosopis glandulosa* Torr. var. *torreyana* (L. D. Benson) M. Johnston, *Stenocereus gummosus, Viscainoa*

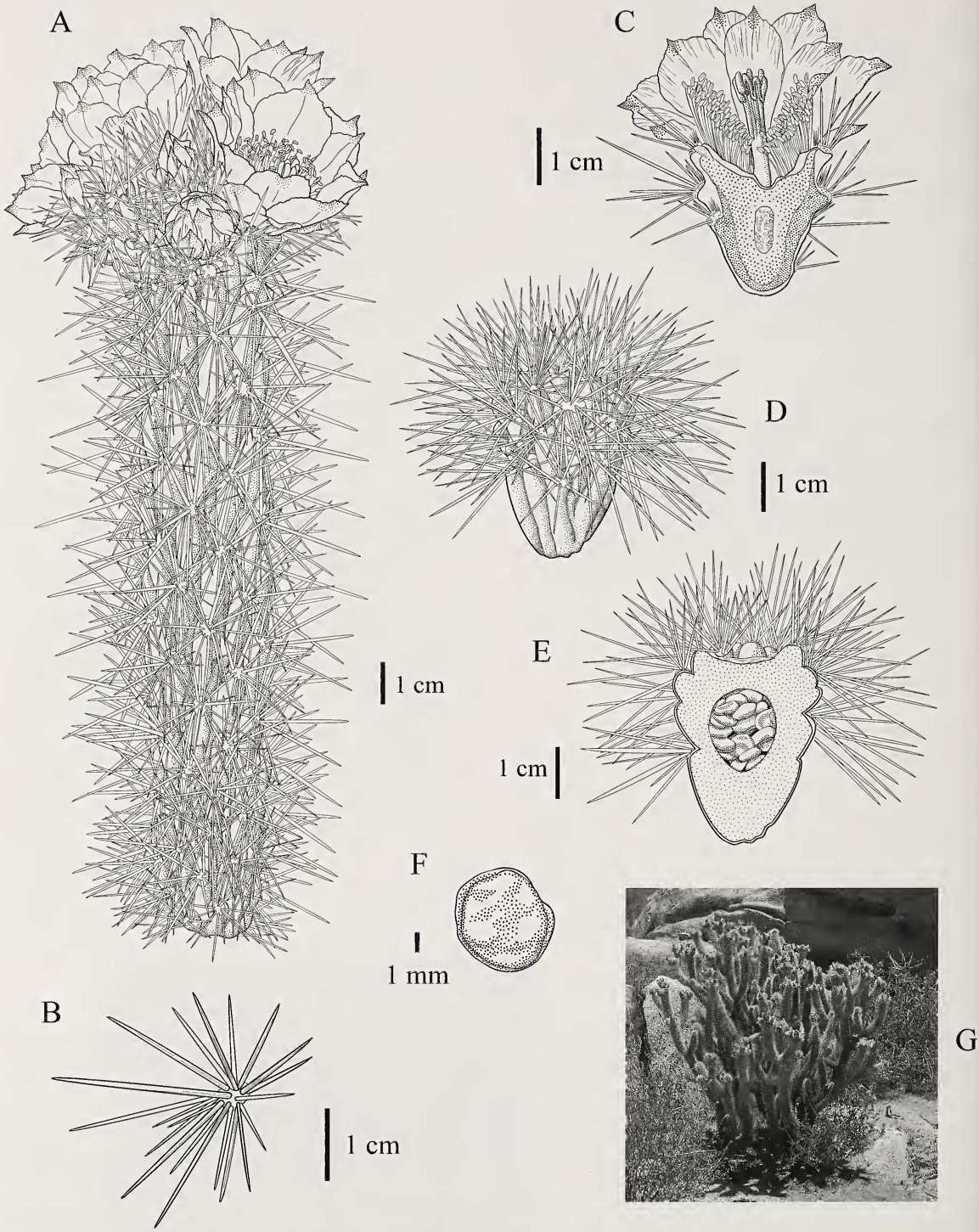

FIG. 5. *Cylindropuntia ganderi* var. *catavinensis* A. Stem segment (*Rebman 2727*, photos *Rebman P04344, P04340*). B. Areole spine cluster (*Rebman 2727*). C. Flower (*Rebman 4986*). D. Fruit (*Rebman 2727*, photo *Rebman P04325*). E. Fruit section (photo *Rebman P04334*). F. Seed (*Rebman 2727*). G. Growth habit (photo *Rebman P22796*). Note: numbered photos are from digital archives on bajaflora.org.

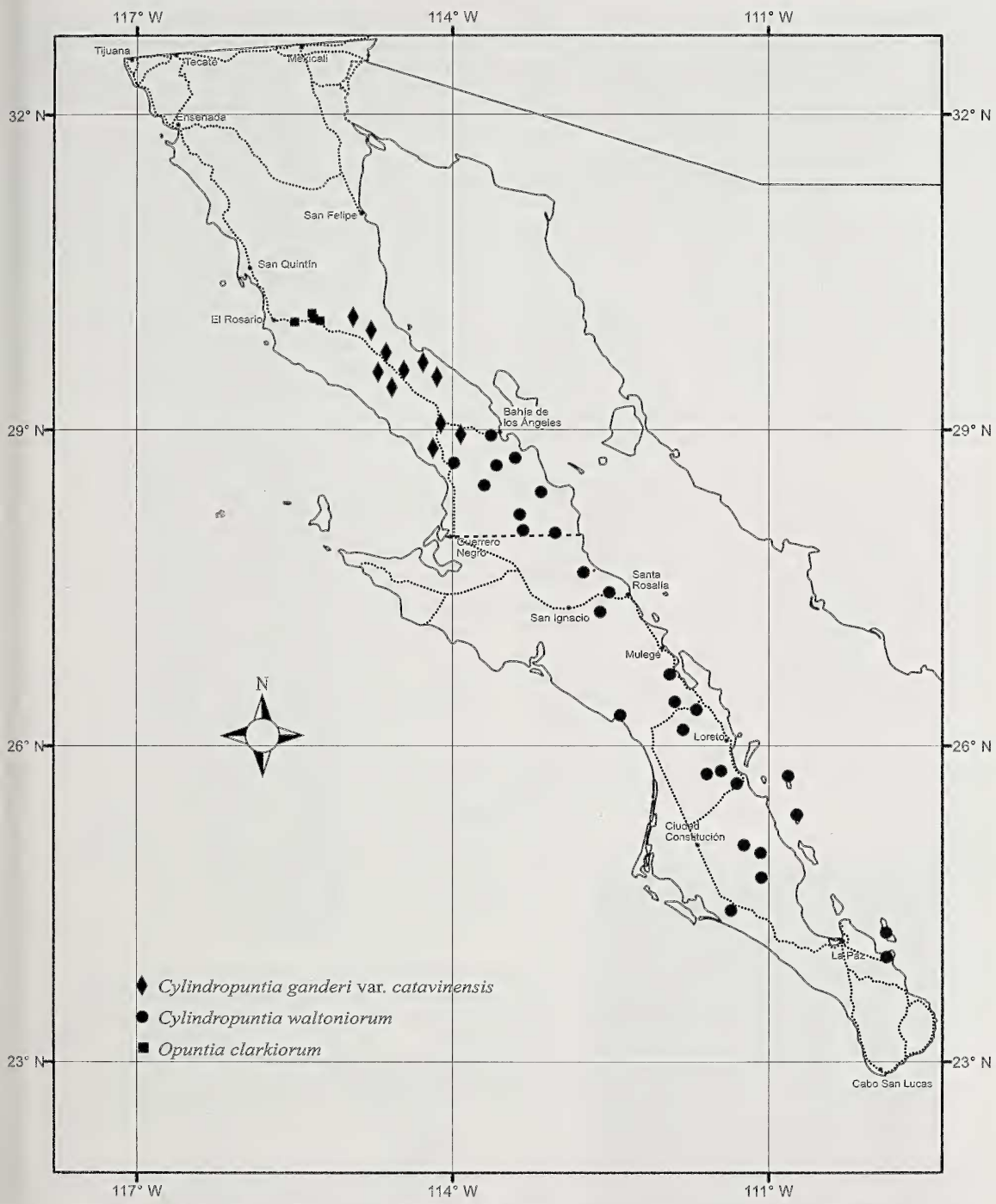

FIG. 6. Map of the Baja California region showing the distribution *Cylindropuntia ganderi* var. *catavinensis* (diamonds), *Cylindropuntia waltoniorum* (circles), and *Opuntia clarkiorum* (squares).

geniculata (Kellogg) Greene var. *geniculata,* and *Yucca valida* Brandegee.

Etymology. The name of this new variety is derived from the town, Cataviña, in BC, where it grows abundantly in the large granite boulder fields of the vicinity. Suggested English common name is Cataviña Cholla.

Taxonomic relationships. Cylindropuntia ganderi var. *catavinensis* has an extremely linear, ascending growth habit and occurs with at least

two different spine color forms (cream to light yellow or pinkish-orange), which can be found together in the same population. It differs from *Cylindropuntia ganderi* var. *ganderi* by having a spinier general appearance, differently colored spines that blacken with age, slightly thicker spines in the central part of each areole, and a more southerly distribution. Although this variety does not seem to have strong quantifiable characters separating it from the typical variety, the two varieties do look very different in the field and do not appear to overlap in their distributions. The more widespread *Cylindropuntia ganderi* var. *ganderi* is extremely variable in stem diameter, spination, and growth habit probably due to populations occurring in very different ecological settings from low desert to higher transitional habitats in the Peninsular ranges of southern California and northern BC. Conversely, *C. ganderi* var. *catavinensis* has markedly different spine colors among different individuals, but in general, most of the plants of this variety look very much the same in respect to growth habit, stem diameter, and spination. In fact, this new variety with its linear ascending branches, spines that are brightly colored on new growth and blackened on older parts, and showy, yellow flowers is one of the most attractive looking chollas in Baja California and should be considered for cultivation in arid landscapes/xeriscapes. *Cylindropuntia ganderi* var. *catavinensis* seems to be restricted to decomposed granite substrates since all populations documented thus far are on this loose, almost sand-like gravel type.

In respect to distribution, the varieties of *Cylindropuntia ganderi* do not seem to overlap. *Cylindropuntia ganderi* var. *ganderi* is one of the most common chollas in the Colorado Desert ecoregion of the Sonoran Desert and grows in desert, chaparral, and pinyon/juniper communities, on sandy flats and rocky hillsides from 200–1500 m in elevation. It is especially common in parts of Anza-Borrego Desert State Park in San Diego County, California. This widespread variety occurs along the Peninsular Ranges from southern Riverside County in California south along the eastern slopes of the Sierra de Juárez as far south as the lower northeastern slopes of the Sierra de San Pedro Mártir. *Cylindropuntia ganderi* var. *catavinensis* is restricted to central BC and occurs from the vicinity of San Agustín and Bahía San Luis Gonzaga south to near Santa Rosalillita and the northern Sierra San Borja. This new variety is especially abundant and dominant in the large granite boulder fields just north of Cataviña.

I have seen unpublished floristic checklists from the Cataviña area listing this taxon as *Cylindropuntia acanthocarpa* (Engelm. & J. M. Bigelow) F. M. Knuth. However, this is just a misinterpretation because *C. ganderi* var. *catavinensis* lacks the red filaments and variable perianth color characteristic of the *Cylindropuntia acanthocarpa* complex, and they do not seem to share a close evolutionary relationship.

It should be noted that both varieties of *C. ganderi* do not readily reproduce asexually because the terminal stem segments are firmly attached to the parent plant. Most young plants seen in the field appear to have germinated from seeds. The almost bur-like fruits of both varieties are usually full of viable-looking seeds. In the Cataviña area, the spiny fruits of *C. ganderi* var. *catavinensis* are found in abundance around packrat/woodrat (*Neotoma* sp.) middens, which are apparently put there as a defense against predators.

KEY TO THE VARIETIES OF *CYLINDROPUNTIA GANDERI*

1. Spines mostly yellow, aging light brown on trunks and older branches; diameter of central spines 0.3–0.7 mm; stem segments appearing somewhat spiny from afar, but tubercles remain salient; tubercles elongate, to 32 mm long; plants of southern California and northern BC as far south as the northeastern foothills of the Sierra de San Pedro Mártir . . . . . *C. ganderi* var. *ganderi*
1′. Spines cream or pinkish-orange, rarely yellowish, aging dark gray to nearly black throughout; diameter of central spines 0.7–1.0 mm; stem segments appearing very spiny from afar, obscuring the tubercles beneath; tubercles generally shorter, to 24 mm long; plants of central and southern BC . . . . . *C. ganderi* var. *catavinensis*

Cylindropuntia libertadensis Rebman, sp. nov. (Figs. 7, 2 map).—TYPE: MÉXICO, Baja California, 113.631°W, 28.5424°N, Sierra La Libertad, in the vicinity of the abandoned Rancho El Paraíso, along the riparian area of Arroyo El Paraíso, 26 Apr 2009, *Rebman 17276* (holotype: SD 194634; isotypes: BCMEX, HCIB).

Large shrubs with open, almost whorled branches, to tree-like with a definite trunk, 1.5–3 m; branch segments easily detached as propagules, sometimes forming sparse clonal populations. Stem segments cylindrical, green to light green, slightly glaucous, (6.5–)11–15 × 2.5–3.6 cm; tubercles salient, narrowly oval, 19–30 × 5–8 mm, 6–9 mm high. Areoles cream, aging gray, 3–5 × 1.5–2 mm. Spines sparse but at most areoles, cream to almost white and light yellow tips, (0)4–6 per areole, (4–)6–13(–16) × 0.4–0.8 mm, the central spines 1–3, the radial spines usually 3; sheaths cream to light yellow, yellow-tipped, slightly baggy. Glochids inconspicuous on stems, light yellow, in apical crescent and tuft, 2–

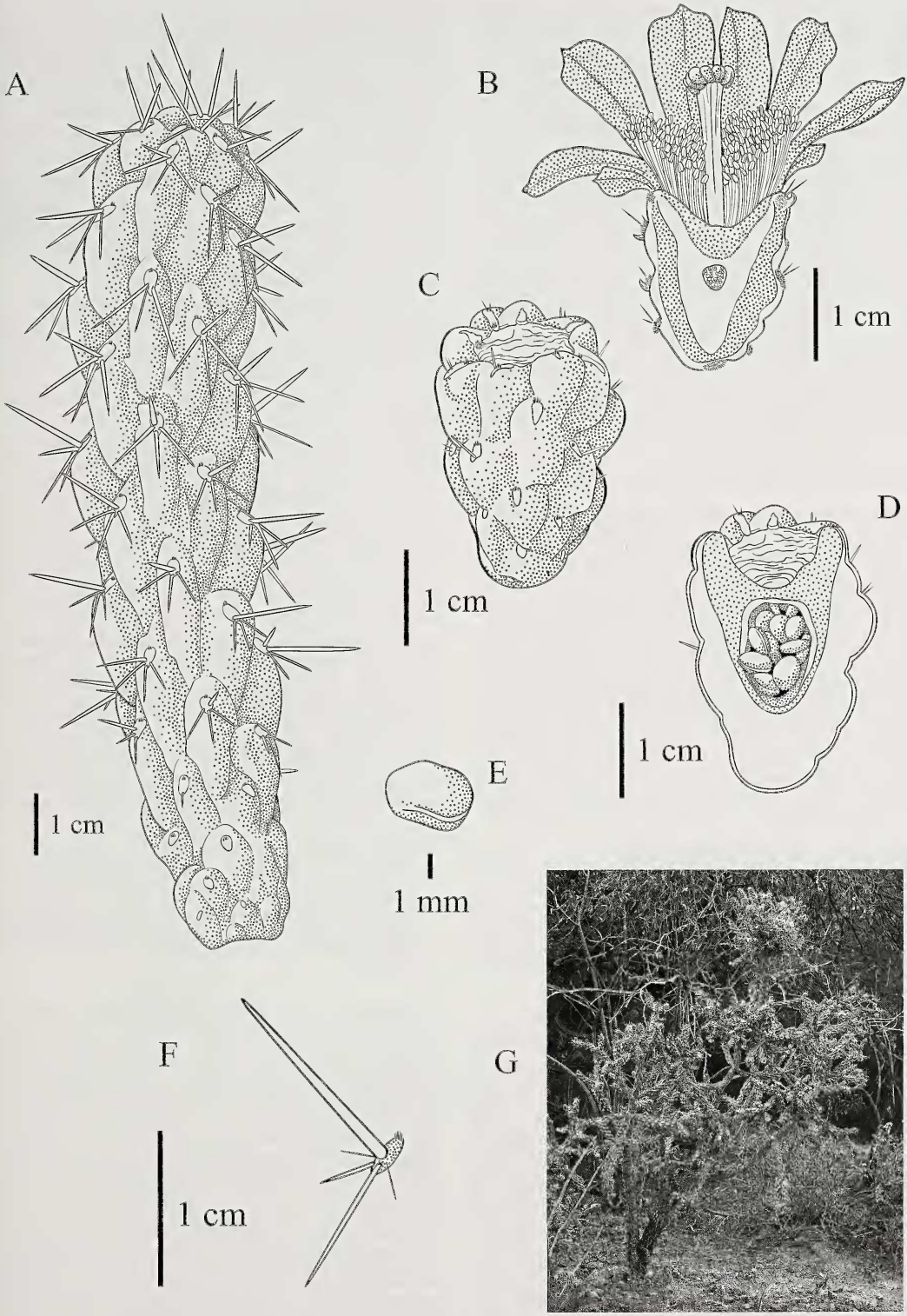

FIG. 7. *Cylindropuntia libertadensis* A. Stem segment (*Rebman 17276*, photo *Rebman P14503*). B. Flower (*Rebman 17276*). C. Fruit (*Rebman 17276*, photo *Rebman P14498*). D. Fruit section (*Rebman 17276*). E. Seed (*Rebman 17276*). F. Areole spine cluster (*Rebman 17276*). G. Growth habit (photo *Rebman P30535*). Note: numbered photos are from digital archives on bajaflora.org.

3 mm, plus (0–)2–4 gray bristle-like glochids among spines, 2–4 mm. Flowers: tepals few, spreading to ascending, the inner tepals deep red to magenta, 15–21 × 6–9 mm, sometimes outer tepals with very light brown midstripe; filaments cream, but commonly pink on those closest to the perianth, 6–9 mm, the anthers yellow, 1.1–1.6 mm; style cream at base and pink apically, to 21 mm; stigma cream to white, the lobes 5–7, 2–3 mm; ovary 15–22 × 13–18 mm, the locule 3–5 × 3–4 mm and its ceiling 1–2 mm thick, the ovules 90–140. Fruits green to greenish yellow with a reddish tinge at maturity, fleshy, spineless, obovate to narrowly obovate, rarely proliferating into a chain of two, (19–)23–35 × 19–25 mm; areoles 24–30. Seeds 0–8, cream to tan, circular or slightly irregular in outline, spheric to slightly compressed laterally, 3.4–5 mm diam. Chromosome number: unknown.

Phenology. Flowering in April.

Distribution and ecology. Central Desert ecoregion of the Sonoran Desert; 650–850 m; endemic to southern part of the state of Baja California, especially common along canyons and on rocky, volcanic hillsides in Arroyo El Paraíso in the Sierra La Libertad between Villa Jesús María and Bahía de los Angeles. This new species is often found in desert/canyon vegetation in association with: *Ambrosia ambrosioides* (Cav.) W. W. Payne, *Brahea armata* S. Watson, *Cylindropuntia cholla, Dodonaea viscosa* Jacq., *Euphorbia lomelii* V. W. Steinm., *Lophocereus schottii* var. *schottii, Myrtillocactus cochal, Pachycereus pringlei, Prosopis articulata* S. Watson, and *Stenocereus thurberi.*

Etymology. This new species is being named with respect to its range of distribution, which is presently only in the Sierra La Libertad of the central part of the Baja California peninsula. Suggested English common name is La Libertad Cholla.

Taxonomic relationships. This rare species has a very limited distribution and has only been seen within the confines of El Paraíso Canyon for a distance of approximately 16 kilometers in the Sierra La Libertad. Although lacking a wide distributional range, this species is quite abundant in this area and often dominates some of the vegetation adjacent to the canyon bottom. In general appearance, this new cholla is very similar to *Cylindropuntia cholla* and even grows in mixed populations with it at times. However, flower color (red vs. pink) along with differences in stem characters (longer stems and shorter tubercles of *Cylindropuntia libertadensis*) easily separate these two species. It is possible that this new taxon is of hybrid origin. In many morphological aspects it is similar to *C. prolifera* of northwestern BC which has been proven by Mayer et al. (2000) to be a product of reticulate evolution via hybridization between *C. cholla* and *C. alcahes.* If one hypothesizes hybridization for this new species, then it is likely that *C. cholla* is one of the putative parents due to general morphological similarities. However, the other parent is still a mystery. One might suspect the sympatric *C. alcahes* var. *alcahes* (the same parental species involved in deriving *C. prolifera*), but this new species differs significantly from *C. prolifera* by its open growth habit, fruits yellowish and barrel-shaped at maturity, seeds normally present, and stems drying black internally.

Further investigation is warranted to obtain more detailed information about *Cylindropuntia libertadensis.* Cytogenetic data would be nice in order to better understand this species' affinities to other chollas. More specimen collections are needed to improve our understanding of this species distribution and range of morphological variation. All of the individuals seen during three days of floristic research in this very remote part of the peninsula were very morphologically consistent and no intermediate individuals between other sympatric cholla species (*Cylindropuntia cholla, C. alcahes* var. *alcahes,* and *C. lindsayi*) were observed. It appears that this cholla species uses some vegetative propagation forming populations as the stem segments dislodge easily and clonal plants were observed growing from both fallen stem joints and from fallen fleshy fruits. However, the seeds within most of the fruits observed in the field appear to be fertile and it is assumed that this species also reproduces by sexual means via seed germination.

Cylindropuntia waltoniorum Rebman, sp. nov. (Figs. 8, 6 map).—TYPE: MÉXICO, Baja California, 113°42′W, 28°41′N, Arroyo near Rancho San Gregorio, Sierra San Borja, 1 Apr 1960, *Moran 8160* (holotype: SD 50831; isotype CAS).

Shrubs, openly branched to monopodial habit, only rarely long-stemmed and tree-like with a definite trunk, 0.7–1.8 m tall, the lateral branches sometimes detached easily. Stem segments cylindrical, light green to gray-green, commonly tinged with purple-brown, especially around the areoles, sometimes glaucous, (3–)5.5–11.5(–14) × (0.6–)0.8–1.3(–1.5) cm; tubercles usually low and elongate, (10–)13–19 × 2–4 mm, 1–4 mm high. Areoles cream, aging gray, 2–3 × 2–3 mm. Spines at most areoles, with gray bases and light orange to yellow tips, (0–)1–3(–6) per areole, all central spines porrect to deflexed, wiry, (10–)17–28(–35) × 0.2–0.5 mm, but occasionally 1–3 small radial spines also present, to 5 mm; sheaths yellow to golden. Glochids sometimes conspicuous, golden-brown or rust-colored, 2–3 mm, in apical tuft, plus 0–4 bristle-like glochids in basal part of areole that are 3–5 mm. Flower (poorly known):

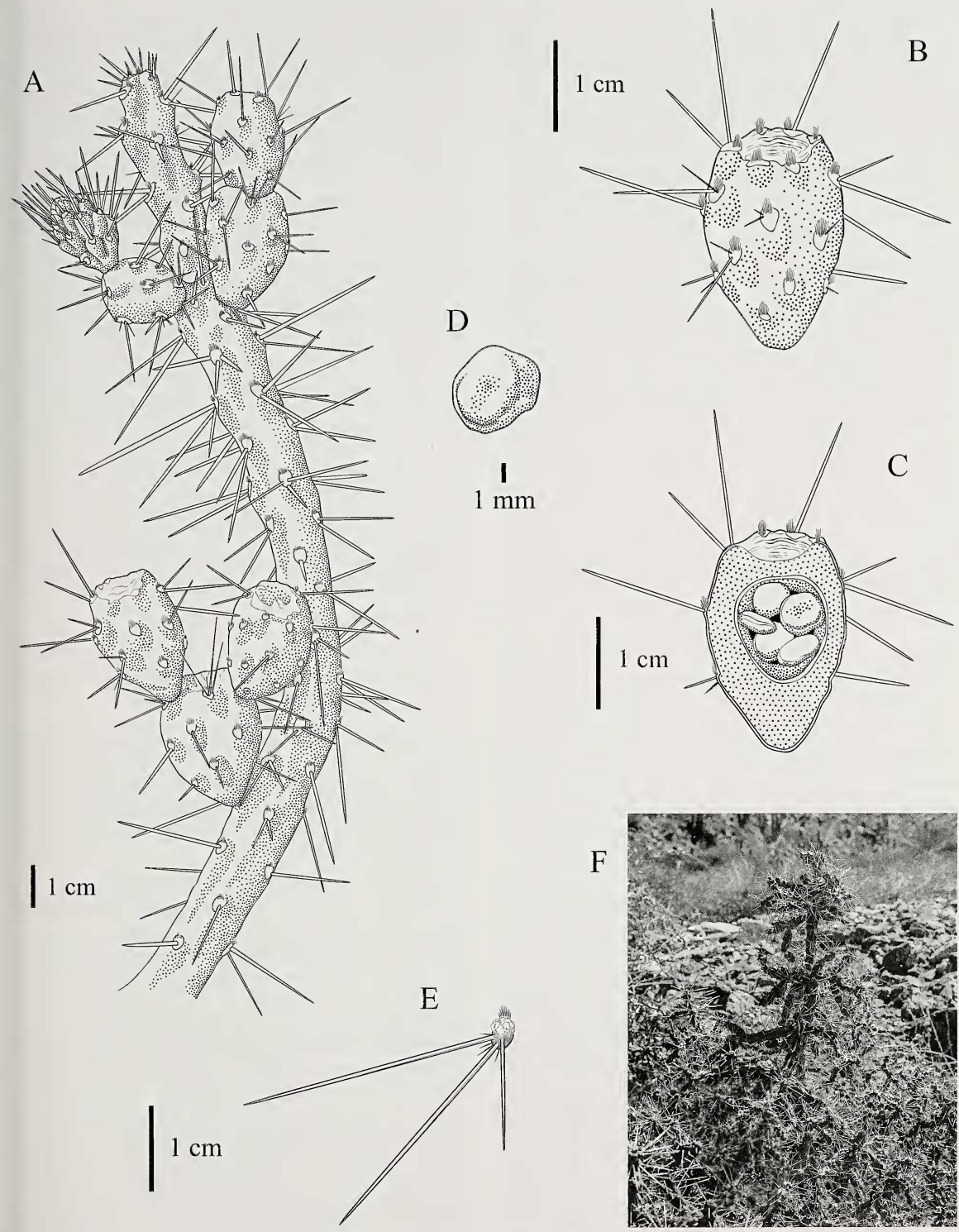

FIG. 8. *Cylindropuntia waltoniorum* A. Stem segment (*Moran 8160*). B. Areole spine cluster (*Moran 8160*). C. Fruit (*Moran 8160*, photo *Rebman P14998*). D. Fruit section (*Moran 8160*, *Rebman 20082*). E. Seed (*Moran 8160*). F. Growth habit (photo *Rebman P04564*). Note: numbered photos are from digital archives on bajaflora.org.

inner tepals red; filaments green. Fruits green to red, fleshy, spineless or with a few scattered spines, obovoid to clavate, sometimes proliferous producing either fruits or stems, 17–25 × (12–) 14–20 mm. Seeds 0–5, tan, compressed laterally, circular in outline, 3.5–5 mm diam. Chromosome number $2n = 44$ (*Baker 8713, Rebman 1162*).

Paratypes: MÉXICO, BAJA CALIFORNIA. 113°25′W, 28°07′N, at ruins of Calmalli, 6.2 mi N of El Arco, 8 Mar 1992, *Baker 8777 & Johnson* (ASU, BCMEX); 113°23′W, 28°04′N, 1 mi N of Pozo Alemán, 5 km NNE of El Arco, 8 Mar 1992, *Baker 8778 & Johnson* (ASU, BCMEX); Las Flores, near Bahía de los Angeles, 13 Apr 1947, *Harbison s.n.* (SD 41908, 41911); 113°48′W, 28°56′N, 23 mi from Bahía de los Angeles on San Borjas Road, 27 Dec 1960, *Lindsay & Parrish 2978* (SD); 3.5 mi W of Santa Gertrudis, 30 Dec 1960, *Lindsay & Parrish 2989b* (SD); 113°20′W, 28°11′N, Rancho Union, 26 May 1961, *Lindsay 3160* (MEXU, SD); 113°18′W, 28°08′N, 10 mi NE of Pozo Alemán, in arroyo by the Barril Road, 3 Apr 1960, *Moran 8166* (CAS, SD); 113°59′W, 28°38′N, E of Rosarito on road to Mission San Borja, 25 Apr 1994, *Rebman 2641 & Hodgson* (ASU, BCMEX, DES, SD); San Benitos Islands, 9 Mar 1911, *Rose 16085* (NY); 13.1 mi N of San Borja, 19 Oct 1967, *Turner 67-73 & Hastings* (CAS, SD). MÉXICO, BAJA CALIFORNIA SUR. 20 km W of Rosarito, ca. km S of Mulegé to the SW of Cerro Concepción, 8 Jan 1982, *Baker 4037* (ASU); 112°46′W, 27°19′N, just S of Rte. 1, Santa María Wash between Cerro Colorado & Cerro Guatamote, 8.3 mi ENE of Guamúchil & 8 mi ENE of San Ignacio, 29 Feb 1992, *Baker 8712, 8713 & Johnson* (ASU, BCMEX); 111°53′W, 26°20′N, N of Los Morros, along road to San Isidro, ca. 22 mi W of Rte. 1, 1 Mar 1992, *Baker 8729 & Johnson* (ASU, BCMEX); 112°06′W, 26°04′N, along coastal Hwy, 7.8 mi S of jct. with road to San Juanico, 2 Mar 1992, *Baker 8735 & Johnson* (ASU, BCMEX); 111°43′W, 26°03′N, Mesa Grande at El Aviadero, 2 km E of San José Comondú, 4 Mar 1992, *Baker 8754 & Johnson* (ASU, BCMEX); San Gregorio, 1889, *Brandegee s.n.* (UC); Concepción Bay, Coyote Bay, 1 mi E of anchorage, 15 Jan 1961, *Lindsay 3005* (SD); 7.9 mi W of San Javier, 1 Apr 1961, *Lindsay & Parrish 3082* (SD); 2.5 mi NW of Bahía de Los Muertos, 20 May 1961, *Lindsay 3140* (SD); 111°19′W, 24°56′N, 0.6 mi NW of San Luis Gonzaga, 21 May 1961, *Lindsay 3142* (SD); 111°19′W, 24°56′N, 0.6 mi N of San Luis Gonzaga, 21 May 1960, *Lindsay 3147* (SD); 6.4 mi W of San Javier, 22 May 1961, *Lindsay 3148* (SD); 110°44′W, 25°16′N, Santa Cruz Island, 18 Apr 1962, *Lindsay 3317* (SD); 110°47′W, 25°39′N, Catalina Island, arroyo bottom at W-base of main ridge, 9 Apr 1962, *Moran 9358* (SD); 112°14′W, 26°07′N, 11 mi WSW of La Purísima, 13 Feb 1973, *Moran 20082* (SD); Rte. 1, ca. 35 mi E of Ciudad Constitución, 28 May 1974, *Pinkava et al. 12259* (ASU); Rte. 1, ca. 35 mi E of Ciudad Constitución, 28 May 1974, *Pinkava et al. 12260, 12261* (ASU); Rte. 1, ca. 10 mi W of Huatamote near Microondas station, 28 May 1974, *Pinkava et al. 12269, 12270* (ASU); 13 km SE of San Ignacio along Rte. 1 near km marker 60, 17 May 1991, *Rebman 1162 & Rice* (ASU, BCMEX); 111°30′W, 24°33′N, riparian zone between Rte. 1 and Punta Chale, 21 May 1992, *Rebman et al. 1390* (ASU, DES, HCIB); 111°44′W, 26°22′N, W of Rte. 1 and San Isidro, 26 May 1992, *Rebman et al. 1410* (ASU, BCMEX, DES, HCIB, SD); 112°46′W, 27°20′N, just S of San Ignacio, 27 May 1992, *Rebman et al. 1412* (ASU, BCMEX, DES, HCIB); 111°08′W, 24°44′N, Rte. 1, S of Ciudad Constitución and a few mi NE of La Fortuna, 19 Apr 1993, *Rebman 1701 & Davis* (ASU, BCMEX); E of Rte. 1, S of Ciudad Constitución and NE of La Fortuna, 19 Apr 1993, *Rebman 1706 & Davis* (ASU, BCMEX, MEXU, SD); Santa Cruz Island, Apr 1911, *Rose 16845* (GH, NY); ca. 112°42′W, 27°25′N, SW of Volcan Las Virgenes, 8.1 mi W of turn to Rancho Las Virgenes, 27 Mar 1986, *Sanders 6333* (ASU).

Phenology. Flowering in April.

Distribution and ecology. Deserts; 50–700 m; southern BC to southern BCS and some adjacent Pacific and Gulf islands.

Etymology. This species is named in honor of John and Christy Walton for their long term support of research, conservation, and education on the Baja California peninsula and in the Gulf of California. Suggested English common name is Waltons' Cholla.

Taxonomic relationships. This new species is a very common entity in the southern half of the Baja California region and appears to have intermediate morphology between *Cylindropuntia alcahes* and *C. lindsayi*. In fact, Rebman (1995) described and referred to as "*C. lindsayi* × *C. alcahes*." It is true that hybridization is a relatively common occurrence between cholla species that are sympatric in at least part of their distribution and that reticulate evolution has created some of the diversity of chollas in northwestern México, i.e., *C. prolifera* (Mayer et al. 2000). In Baja California, naturally occurring putative interspecific hybrids have been documented from parent species including *C. alcahes, C. bigelovii* (Engelm.) F. M. Knuth, *C. californica* (Torr. & A. Gray) F. M. Knuth, *C. cholla, C. ganderi, C. lindsayi, C. molesta, C. prolifera, C. ramosissima* (Engelm.) F. M. Knuth, and *C. tesajo* (Engelm.) F. M. Knuth. However, most of these suspected hybrids are either rare individuals or small populations with limited distributions.

Although *Cylindropuntia waltoniorum* might be of hybrid origin, it is so common in many areas of the peninsula that practicality deems it necessary to name and describe. This new species is mostly found within the distributional range of *C. lindsayi,* but there are significant populations outside of the distribution of *C. lindsayi.* Most of the individuals of *C. waltoniorum* are morphologically more similar to *C. lindsayi* than to *C. alcahes* and have an irregular monopodial growth habit and spines that are usually thin and wiry to thread-like. However, much variation does exist in this taxon and may be the result of either genetic diversity or, if a nothospecies, possibly different genome combinations and/or ploidy levels. Although commonly collected due to its wide distribution, only a few specimens have been encountered with floral characters. Many collections have been made that are vegetative or with fruits, but more information on the colors and sizes of floral parts is needed. The fruits can be green or red, spineless or rarely with a few scattered spines, and infrequently stems are produced from the areoles on the fruits. Most individuals suggest a strong affinity to *C. lindsayi,* but *C. lindsayi* has a smaller stem diameter (4–8 mm), greenish-yellow flowers, and stouter spines (>0.5 mm wide), which allows for easy differentiation of these two chollas.

If one considers the possibility that *C. waltoniorum* is a hybrid between *C. lindsayi* and *C. alcahes* then it is conceivable that at least two varieties of *C. alcahes* (var. *alcahes* and var. *burrageana*) might hybridize with *C. lindsayi* when sympatric to create the observed intermediacy found in individuals throughout its range. However, this most likely hybrid combination would be with *C. alcahes* var. *alcahes,* which is the most common and widespread taxon of *C. alcahes* in the sympatric region. Like both putative parental species, *C. waltoniorum* is very successful at asexual reproduction via vegetative propagation of the stems, which allows it to persist and spread. Waltons' Cholla is well-adapted for vegetative propagule dispersal because the spines are retrorsely barbed and the terminal stem segments easily detach from the parent plant.

This enigmatic new species occurs commonly within the distributional range of the putative parent *C. lindsayi,* but it has also been documented on Santa Catalina, Santa Cruz, and Cerralvo islands in the southern Gulf of California where *C. lindsayi* is not known to occur. Another factor that supports its recognition as a separate and described species is that the chromosome counts recorded thus far confirm that it is a tetraploid, whereas *C. lindsayi* is a tetraploid and *C. alcahes* var. *alcahes* is mostly a diploid (although a couple of rare triploid counts have been made). Therefore, an F1 interspecific hybrid between these two parent species would presumably be a triploid taxon.

Opuntia clarkiorum Rebman, sp. nov. (Figs. 9, 6 map).—TYPE: MÉXICO, Baja California, 115°30′48″W, 30°02′17″N, southeast of El Rosario: along Highway 1, 11.4 miles north of the road to Los Mártires, 4 Jun 1998, *Rebman 5329 & S. Villarreal* (holotype: SD 143386; isotypes ASU 229797, BCMEX 11133).

Shrub, with a definite trunk and profuse, spreading branches, 1.8–2.5 m tall and up to 4 m diam.. Stem segments (reproductive cladodes) flattened, circular, shiny, glabrous, deep to light green, with even and moderately dense spination, (14–)19–23(–25) × (12–)14–16(–19.5) cm, 27–44 (–46) areoles per half cladode, 6–8 parastichies per cladode, 7–8 areoles on the central-most parastichy with each areole (23–)25–32(–35) mm apart. Areoles light gray to rust colored, aging gray, 4–6(–7) × 4–5(–6) mm. Spines at most areoles, with brown to red-brown bases and cream to yellow tips and with very obvious alternating light and dark color bands along the spine, (0–)3–7(–9) per areole, central and radial spines intergrading and difficult to separate, stout, terete to slightly flattened at base, (17–)19–27(–35) mm long, but occasionally 1–3 small radials at base of areole also present, 5–10 mm long. Glochids sometimes conspicuous, yellow to light brown, 3–5 mm, in apical tuft, plus scattered along most of the areole margin. Flower: inner tepals yellow aging peach; style cream to light pink, stigma green, filaments cream to yellow. Fruits deep red at maturity, fleshy, spineless (with only glochids present), ovoid to globular, 30–38 × (23–)25–34 mm. Seeds many, tan or with dark gray center, compressed laterally, circular in outline, 2–4 mm diam. Chromosome number $2n = 66$ (*Rebman 5329,* type).

Paratypes: MÉXICO, BAJA CALIFORNIA. 115°21′W, 30°06′N, between El Rosario and Cataviña, N of Rancho Los Mártires; ca. 4.6 mi N of Hwy 1, 11 Jun 1998, *Rebman 5365* (ASU, BCMEX, SD); 115°17′W, 30°02′N, along Highway 1 between El Rosario and Cataviña, 3.8 miles S of the road to Los Mártires, north of Guayaquil, 5 Jun 1998, *Rebman 5338* (ASU, BCMEX, SD); 115°20′W, 30°03′N, between El Rosario and Cataviña, along Highway 1, just S of the road to Rancho Los Mártires, 3 Nov 1998, *Rebman et al. 5873* (BCMEX, SD).

Phenology. Flowering in June.

Distribution and ecology. Sonoran Desert in the northwestern part of the Central Desert ecoregion and rarely in the extreme southeastern part of the Coastal Succulent Scrub ecoregion; 270–580 m elevation; endemic to the northwest-central part of the state of Baja California, especially

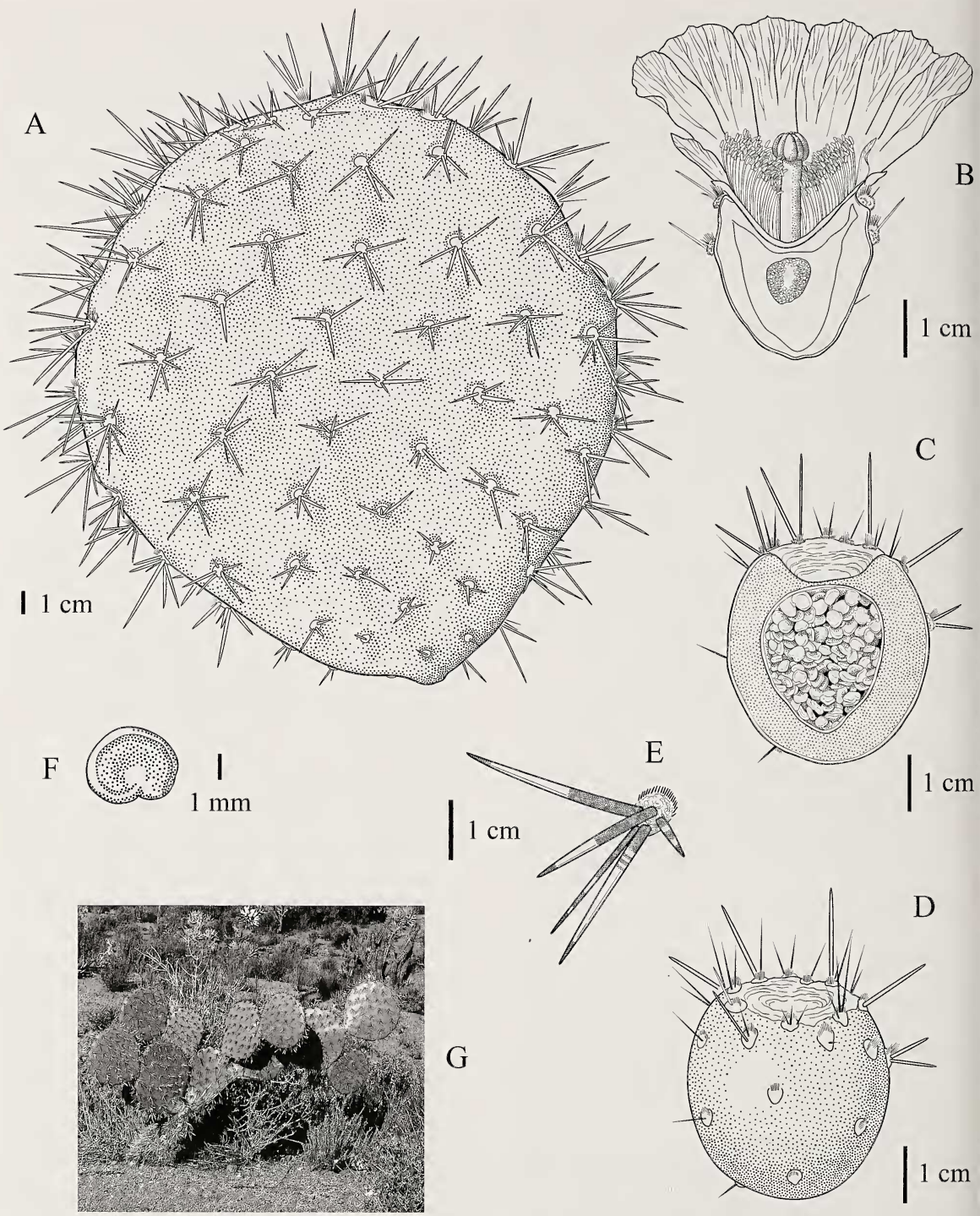

FIG. 9. *Opuntia clarkiorum* A. Stem segment (*Rebman 5329*). B. Flower (*Rebman 5365*). C. Fruit section (*Rebman 5329*, photo *Rebman P15107*). D. Fruit (*Rebman 5329, Rebman 5365*). E. Areole spine cluster (*Rebman 5329*). F. Seed (*Rebman 5329*). G. Growth habit (photo *Rebman P04692*). Note: numbered photos are from digital archives on bajaflora.org.

common on flats and hillsides from just southeast of the vicinity of El Rosario south to site of Misión San Fernando Velicatá. This new variety is mostly found in central desert vegetation in association with: *Agave cerulata* Trel. subsp. *nelsonii* (Trel.) Gentry, *Agave shawii* subsp. *goldmaniana* (Trel.) Gentry, *Bahiopsis laciniata, Cylindropuntia cholla, C. molesta var. molesta,*

Fouquieria columnaris, Larrea tridentata, Lophocereus schottii var. *schottii, Pachycereus pringlei, Simmondsia chinensis* (Link.) C. Schneider, and *Stenocereus gummosus.*

Etymology. This species is named in honor of Mary and Dallas Clark for their long term support of natural history research in the southern California and Baja California regions. Common name: Clarks' Prickly-pear.

Taxonomic relationships. This new species is similar in general appearance to *Opuntia oricola* Philbrick and *Opuntia* × *occidentalis* Engelm. & J. M. Bigelow that occur in the California Floristic Province of coastal southern California and rarely in extreme northwestern BC, but this new species is unique from all other *Opuntia* species in the region in having obvious and distinctive color banding along the length of the spines. Although similar in general habit and stem morphology to *O. oricola*, it differs in having longer spines, spines arranged in the upper and lower parts of the stem areole, spines arranged in a spreading and ascending manner with no curved spines present, and fewer areoles per cladode. It is also somewhat similar to *Opuntia* × *occidentalis*, but differs in being a much larger plant with shiny round, deep green versus dull gray-green obovate cladodes, and has more spines per areole.

This distinctive new species found primarily in the Sonoran Desert has a limited distribution, but is quite abundant in that area and can easily be seen along the roadside of Hwy. 1 between El Rosario and San Agustín. Perhaps only by coincidence, the distribution of this new *Opuntia* is almost identical to the range of *Agave cerulata* subsp. *nelsonii,* another localized endemic taxon in this area.

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Literature Cited

Anderson, E. F. 2001. The cactus family. Timber Press, Inc, Portland, OR.

Britton, N. L. and J. N. Rose. 1963. The Cactaceae: descriptions and illustrations of plants of the cactus family, Vol. 1. Dover Publication, New York, NY.

Guilliams, C. M., M. G. Simpson, and J. Rebman. 2011. *Calyptridium parryi* var. *martirense* (Montiaceae), a new taxon endemic to the Sierra de San Pedro Mártir, Baja California, México. Madroño 58:259–267.

León de la Luz, J. and J. Rebman. 2010. A new *Ambrosia* (Asteraceae) from the Baja California Peninsula, México. Boletín de la Sociedad Botánica de México. 86:65–70.

Mayer, M. S., L. M. Williams, and J. Rebman. 2000. Molecular evidence for the hybrid origin of *Opuntia prolifera* (Cactaceae). Madroño 47:109–115.

Pinkava, D., B. Parfitt, M. Baker, and R. Worthington. 1992. Chromosome numbers in some cacti of western North America - VI, with nomenclatural changes. Madroño 39:98–113.

Pinkava, D. J., J. Rebman, and M. Baker. 1998. Chromosome numbers in some cacti of western North America - VII. Haseltonia 6:32–41.

Rebman, J. 1995. Biosystematic study of *Opuntia* subgenus *Cylindropuntia* (Cactaceae), the chollas of Lower California, México. Ph.D. Dissertation. Arizona State University, Tempe, AZ.

———. 1997. *Opuntia lindsayi*, a new cholla (Cactaceae: *Opuntia* subgenus *Cylindropuntia*) from Lower California, México. Cactus and Succulent Journal (Los Angeles) 69:67–70.

———. 1999. A new cholla (Cactaceae) from Baja California, México. Haseltonia 6:17–21.

———. 2001. Succulent diversity in Lower California, México. Cactus and Succulent Journal (Los Angeles) 73:131–138.

———. 2006. A new club cholla, *Grusonia robertsii* (Cactaceae) from Baja California Sur, México. Madroño 53:280–283.

——— and F. Chiang. 2005. A new species of *Amyris* (Rutaceae) from Baja California Sur, México. Novon 15:350–353.

——— and D. Pinkava. 2001. *Cylindropuntia delgadilloana*, a new cholla (Cactaceae) from Baja California, México. Journal of the Arizona-Nevada Academy of Science 33:154–156.

Simpson, M. G. and J. Rebman. 2013. A new species of *Cryptantha* (Boraginaceae) from the Sierra de San Pedro Mártir, Baja California, México. Madroño 60:35–45.

Wiggins, I. L. 1980. Flora of Baja California. Stanford University Press, Stanford, CA.

Appendix 1

Key to the Species of *Cylindropuntia* in Baja California, México

1. Fruits dry at maturity (sometimes slow-drying in *C. californica*, *C. munzii*, and *C. santamaria*), cream, tan, or gray.
   2. Stem diam. 5–13 mm; areoles deltoid to linear; spines absent to localized in zones at uppermost areoles of stem segments, rarely scattered throughout.
      3. Stem tubercles inconspicuous; fruits spineless, bearing only long glochids; flowers yellow to yellowish-green . . . . . *C. tesajo*
      3′. Stem tubercles rhomboid to diamond-shaped, conspicuous; fruits usually bur-like with bristle spines; flowers typically bronze to magenta . . . . . *C. ramosissima*
   2′. Stem diam. greater than 17 mm; areoles circular; spines present in most areoles, rarely absent.
      4. Inner tepals yellow-bronze to red-magenta; filaments red-magenta; style pink to red
         5. Branches compactly arranged; stems 33–42 mm diam., spines densely arranged, obscuring tubercles beneath; major spines 17–25 mm long, with sheaths tight-fitting . . . . . *C. wolfii*
         5′. Branching habit usually open and spreading; stems 22–35 mm diam., spines less closely arranged, tubercles visible beneath; major spines 26–44 mm long, with sheaths obviously baggy . . . . . *C. sanfelipensis*
      4′. Inner tepals yellow to green; filaments green; style cream, yellow, or green, rarely pink-tinged
         6. Stem tubercles generally short, 11–18 mm long; inner tepals green to red-maroon
            7. Mostly trees taller than 1.5 m, with terminal branches drooping; major spines of stem segments 12–30 mm long, usually 7–12 per areole; fruits spineless, bearing only long glochids . . . . . *C. munzii*
            7′. Mostly low shrubs (in BC) 0.5–1.5 m tall, with terminal branches rigid; major spines of stem segments 30–46 mm long, usually 13–19 per areole; fruits heavily spined . . . . . *C. echinocarpa*
         6′. Stem tubercles usually elongate, 15–30 mm long; inner tepals yellow
            8. Major branches strict and ascending; tubercles not forming ribs; lower parts of plant obviously darkening with age; fruits densely spiny to bur-like, drying quickly. . . . . *C. ganderi*
            8′. Major branches erect or sprawling; adjacent tubercles sometimes confluent into ribs; older stem portions not conspicuously darkened; fruits moderately spiny to spineless, commonly slow-drying
               9. Stems erect to decumbent, 1.7–3.8 cm wide, occasionally with ribs; spines of stem 1–13 per areole; seeds 4–7 mm diam.; plants from BC and southern California. . . . . *C. californica*
               9′. Stems procumbent and scrambling, 3–4.5 cm wide, usually with ribs; spines of stem 20–26 per areole; seeds 3–4.5 mm diam.; known only from Magdalena Island, BCS . . . . . *C. santamaria*
1′. Fruits fleshy at maturity, green, yellow (sometimes red- to purple-tinged), or red.
   10. Fruits wider than long, strongly compressed apically, umbilicus deep (10–11 mm); insular species endemic to Cedros and San Benitos Islands . . . . . *C. cedrosensis*
   10′. Fruits shape as long as or longer than wide, clavate, barrel-like, globose, or cylindric; umbilicus usually shallow (<8 mm deep); plants insular and/or peninsular but not restricted to Cedros and San Benitos Islands.
      11. Terminal mature stem segments narrow, usually 4–13 mm wide, mostly alternate; major spines 0–3(–6) per areole.
         12. Growth habit monopodial; terminal stem width 4–8 mm; major spines stout (>0.5 mm diam.); flowers greenish-yellow; fruits red at maturity, with scattered spines . . . *C. lindsayi*
         12′. Growth habit pseudomonopodial to open; terminal stem width 8–13(–15) mm; major spines thin and wiry (0.2–0.5 mm diam.); flowers reddish; fruits generally green to yellow or rarely red at maturity, spineless or with a few scattered spines . . . . . *C. waltoniorum*
      11′. Terminal mature stem segments thicker, usually 15–55 mm wide; commonly whorled, subwhorled, or sometimes alternate; major spines generally 5–21 per areole.
         13. Filaments red to magenta; fruits spiny, at least with a few scattered spines
            14. Shrubs erect, ascending; terminal branchlets not easily detached from parent plant; longest central spine (15–)22–29(–35) mm long; seeds usually compressed laterally, 3–5 mm diam. . . . . *C. calmalliana*
            14′. Trees or shrubs, variously spreading; terminal branchlets easily detached as propagules; longest central spine usually 34–48(–56) mm long; seeds irregularly spheric, 4–7(–8) mm diam . . . . . *C. molesta*
         13′. Filaments white, green, or pink; fruits spineless, but commonly bearing deciduous glochids
            15. Stem tubercles angular, obdeltoid, closely arranged; spines of lower branches browning conspicuously; fruits strongly tuberculate, yellow, not proliferating
               16. Plants usually trees with a definite trunk; stem segments very spiny, obscuring the tubercles; spines usually 7–11 per areole; tubercles of fruit low, to 3 mm high. . . . . *C. bigelovii*

16′. Plants generally shrubs with multiple trunks; stem segments less spiny, exposing the tubercles beneath; spines usually 3–5 per areole; tubercles of fruit prominent, to 5 mm high . . . . . *C. ciribe*

15′. Stem tubercles rounded, set close or far apart; spines gray or black on older branches, not obviously browning; fruits usually smooth, rarely low-tuberculate, green or yellow, commonly proliferating

17. Stem tubercles not prominent, except in *C. prolifera*; stems usually drying tan to gray internally.

18. Tubercles broadly oval; spines generally 14–28(–37) mm long; flowers red to magenta; fruits green, usually sterile and proliferating; . . . . . *C. prolifera*

18′. Tubercles elongate-obovoid to narrowly oval; spines 4–20 mm long; Flowers yellow, green, or red–magenta; fruits green or yellow, usually with 5–50 seeds, occasionally proliferating (especially in *C. alcahes* vars. *mcgillii* and *gigantensis*); . . . . . *C. alcahes*

17′. Stem tubercles very prominent; stems usually drying black internally.

19. Inner tepals red-magenta (plants restricted to Sierra de La Libertad, BC), styles cream at base and pink apically . . . . . *C. libertadensis.*

19′. Inner tepals, styles pink.

20. Fruits globose, commonly proliferating into short, erect chains of 2–5 fruits; stem spines stout (0.5–1.1 mm thick); seeds 1.7–2.7 mm diam . . . . . *C. cholla*

20′. Fruits clavate to obovoid, usually forming long, pendant chains; stem spines thinner and more flexible (0.2–0.5 mm thick); seeds 2.4–3.5 mm diam . . . . . *C. fulgida*